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Ministry of Energy, Mines
and Petroleum Resources
Hon. Anne Edwards, Minister

MINERAL RESOURCES DIVISION
Geological Survey Branch

# GEOLOGY AND MINERAL RESOURCES OF THE BABINE MOUNTAINS RECREATION AREA

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# SUMMARY

The Babine Mountains Recreation Area in west central British Columbia is a candidate for Class A park status. At the request of the Ministry of Environment, Lands and Parks, in accordance with the requirements of Section 19 of the *Mineral Tenure Act*, the Ministry of Energy, Mines and Petroleum Resources has conducted a mineral resource potential study, the results of which are presented herein.

There is concern that potentially economic resources may be included if the area is reclassified from a recreation area to a park without provision to test this possibility by allowing mineral exploration first. The present recreation area boundary encompasses a metal resource-rich region:

- there are twenty-three mineral prospects of which seven are past-producing mines,
- prospects contain identified resources in the ground,
- three of the prospects were found during the course of this study which demonstrates favourable mineral potential for the area.

The early history of mineral exploration in the region is essentially coincident with the population influx of the post fur-trade era. Many of the pioneering explorers, prospectors and miners have lent their names to the mountain peaks, rivers, creeks and trails within the area. Many of the prospects date to the turn of the century. Not surprisingly, the vast majority of the mineral claims predate the establishment of the recreation area.

The Babine Mountains Recreation Area is 15 kilometres northeast of Smithers and covers much of the southern part of the Babine Range (Figure 1). The region is underlain by volcanic and sedimentary rocks 65 to 200 million years old; granitic rocks are the youngest rocks and are generally less than 65 million years old. The rocks accumulated in subaerial to submarine environments, which are analogous to a modern volcanic island-arc, such as the Aleutian volcanic mountain chain of Alaska. The nature and distribution of metallic mineral deposits in the recreation area is a reflection of processes that were active during and after deposition of the hostrocks: these include intrusion of granitic rocks with circulation of metal-rich hydrothermal fluids, and development of faults and fracture zones along which metal-rich hydrothermal fluids were focussed.

Three types of metallic mineral deposits occur within the Babine Mountains Recreation Area (Figure 2): porphyry copper-molybdenum deposits associated with granitic ocks (such as the Big Onion deposit), silver-rich polymetallic veins associated generally with volcanic and sedimentary rocks (such as the Cronin deposit) and copper-silver veins contained in volcanic rocks (as at the Drift prospect).

Historical production of metal has been from silver-rich polymetallic veins and basalt-hosted copper-silver veins: past-producers were mostly small-scale operations because of the small size of the deposits. By comparison, the porphyry copper-molybdenum deposit at the Big Onion dwarfs other mineral deposits in the area (Figure 2).

The evaluation of the mineral resource potential of the recreation area required the integration of all available geological, geochemical and mineral occurrence information. Mineral potential estimates rate the probability that an area contains mineral deposits of a particular type, based on the presence of favourable criteria. Favourable criteria include: the presence of favourable geology (as determined by geological mapping); anomalous concentrations of characteristic base or precious metals in rock or stream-sediment samples; and the nature of known mineral occurrences (such as mineral showings, prospects, developed prospects with identified resources, and past-producers). Areas where favourable criteria overlap (for a particular mineral deposit type) indicate a greater degree of confidence, or an increased likelihood for a mineral deposit to occur: these areas are therefore assigned a higher mineral potential.

Three domains of high to extreme mineral potential were outlined during this study (Figure 1). Domain A has very high potential for silver-rich polymetallic veins, and includes identified metal resources at the Cronin mine, four other past-producers and eight prospects (including three found during this study). The region is centred about a volcanic complex at Mount Cronin, which is thought to be an important source of metals for these deposits (Figure 2): consequently, there is potential for silver-rich polymetallic veins across the central part of the recreation area. Much historical interest in silver-rich polymetallic veins has been focussed at the metal resources that remain underground at the Cronin mine (Table 1). At this time, however, there is little exploration or development of silver-rich polymetallic veins.

Domain B has high to very high potential for basalt-hosted copper-silver veins, and includes two past-producers and three prospects: the domain generally outlines the distribution of the favourable hostrocks to these veins.

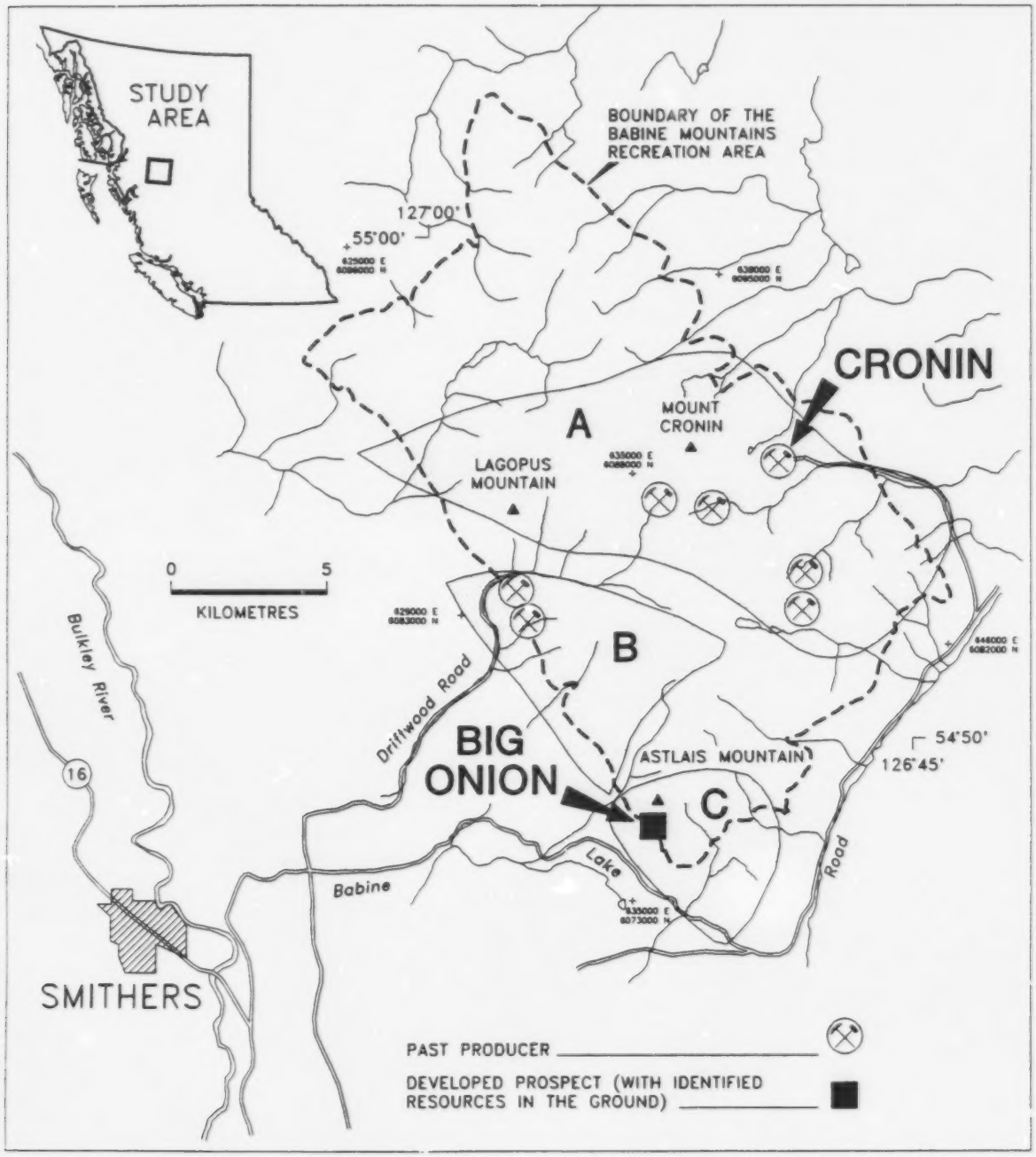


Figure 1. High to extreme mineral potential domains within the Babine Mountains Recreation Area: Domain A has very high potential for silver-rich polymetallic veins, Domain B has high to very high potential for basalt-hosted copper-silver veins and Domain C has extreme potential (or, identified resources in the ground) for porphyry copper-molybdenum-gold-silver mineralization.

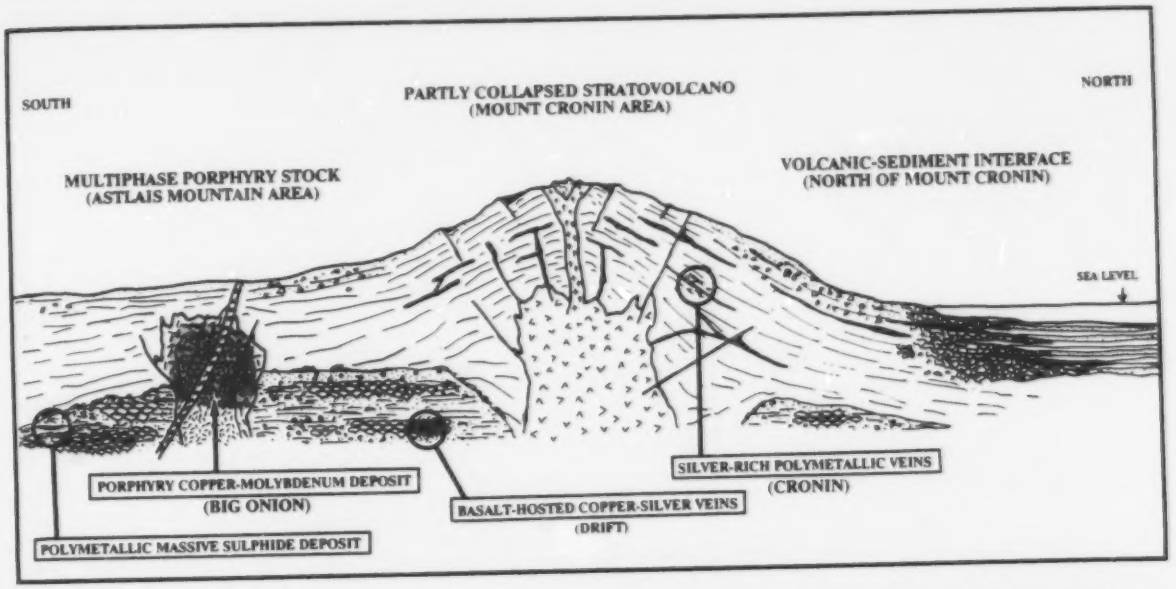


Figure 2. Composite metallogenic model for mineral deposits within and adjacent to the Babine Mountains Recreation Area.

TABLE 1
COMPARATIVE VALUE OF THE BIG ONION AND CRONIN MINERAL DEPOSITS

| MINERAL DEPOSIT TYPE | DEPOSIT NAME | ESTIMATED SIZE OF DEPOSIT | GROSS DOLLAR VALUE OF CONTAINED METALS[1] |
|---|---|---|---|
| Porphyry Cu-Mo | BIG ONION | 94 441 000 t[2] | $1150 Million (CDN) |
| Silver-Rich Polymetallic Veins | CRONIN | 47 210 t[3] | $13 Million (CDN) |

[1]Gross dollar value of metals in the ground before development, mining and extraction costs (net value of extracted metals will be considerably less ): see Appendix A for an account of the metals present, the approximate quantities and their gross dollar value.
[2]Calculation by Stock (1977a)
[3]From Melville et al, (1992)

Although there is very good potential for additional copper-silver veins to be found, they are generally small and discontinuous and are not attractive exploration targets at this time.

Domain C has extreme potential (there are identified metal resources in the ground) for porphyry copper-molybdenum-gold-silver mineralization. The domain surrounds the Big Onion deposit and areas to the east and southeast which include one prospect and several alteration zones with high concentrations of copper, molybdenum and gold. The Big Onion deposit is a low-grade, large-tonnage deposit associated with a multiphase igneous pluton in the Astlais Mountain area (Figure 2) and has considerable size and potentially significant value (Table 1). Porphyry deposits have been a major focus of exploration and development in British Columbia in recent years. The proximity of the Big Onion deposit to the town of Smithers is advantageous: if development were to

proceed, exploration and development costs could be moderate while the capital invested would boost the local economy.

The present boundary of the Babine Mountains Recreation Area cuts through the middle of the Big Onion deposit (Figure 1) which would make further development of this deposit unlikely. A proposed modification to the boundary excludes the Big Onion deposit and a buffer zone, and recommends the addition of a comparable-sized area of pristine alpine meadow and wetland at the headwaters of Harold Price Creek at northwest end of the recreation area. This latter area has a low mineral potential.

# INTRODUCTION

## BACKGROUND

The Babine Mountains Recreation Area covers much of the southern part of the Babine Range, 15 kilometres northeast of the town of Smithers in west-central British Columbia (Figure 3). Before the arrival of Europeans, the Babine Range marked the boundary between the territories of the Na'doet'en (Babine People) to the east and the Wet'suwet'en (People of the Watsonquah) to the west (L'Orsa, 1990). The name Babine (French for "hanging lip") was applied by voyageurs of the North West or Hudson's Bay Companies to the lake, river and neighbouring mountains frequented by Indians that wore ornaments (generally wooden labrets) in the lower lip (Dawson, 1881).

The region has an exploration and mining history that began early in the century, and has included base and precious metal production from several mines. Numerous roads and trails within the recreation area were originally built to provide access to mineral deposits in alpine regions; in some cases the cost of trail building was subsidized by the British Columbia government. Many of these trails are still used by both prospectors and hikers to reach the high country.

The region covered by the recreation area was initially within the bounds of the much larger Babine Mountains Integrated Management Unit created in September, 1976 to ensure better land management and to limit the use of all-terrain vehicles in these alpine and subalpine areas. An exception to this was the creation of a special zone in the Ganokwa basin to allow for snowmobiling during winter months (Babine Master Plan Study Team, 1991).

The Babine Mountains Recreation Area was established in April, 1984 as a step towards formal park status, and comprises approximately 32 400 hectares of territory that ranges in elevation from 1065 to 2385 metres above sea level (Figure 3). The boundary was drawn to exclude most of the peripheral land generally lower than 1370 metres elevation where there are stands of commercial timber, thereby avoiding conflict with the forest industry (Babine Master Plan Study Team, 1991). The southern most boundary of the recreation area was deliberately positioned to include Astlais ("Big Onion") and "Little Onion" mountains south of Ganokwa basin, but in doing so unintentionally bisected the Big Onion copper-molybdenum-gold-silver deposit.

The recreation area is open to 1-post claim staking and mineral exploration, as provided for in Section 19 of the *Mineral Tenure Act*. The use of motorized vehicles is strictly prohibited, except under special permit. Snowmobiling, however, is still permitted in the Ganokwa Basin.

## SCOPE OF PRESENT STUDY

The British Columbia Ministry of Environment, Lands and Parks (M.E.L.P.) has proposed to upgrade the Babine Mountains Recreation Area to full Class A provincial park status to provide for increased protection of its scenic and wildlife resources and to establish official park boundaries. However, current government policy states that land will not be excluded from the mineral exploration land-base before the mineral resource potential has been evaluated. Thus, in accordance with the formal request of the M.E.L.P., the Geological Survey Branch (G.S.B.) of the Ministry of Energy, Mines and Petroleum Resources has conducted a mineral resource assessment of the recreation area. The field-based component of the project was carried out by a helicopter-supported two-person crew during late July and early August, 1991. Office-based research, compilation and writing continued into the spring of 1992.

The program was designed to augment geological mapping and metallogenic studies in the area by MacIntyre *et al.* (1987) and MacIntyre and Desjardins (1988a, b, and unpublished data): their geological map and database provided the foundation for the project. The north part of the recreation area not included in previous mapping programs was examined during this study, including a small region northwest of the recreation area near the headwaters of Harold Price Creek (Figure 3).

Regionally extensive belts of pyritic and limonite-stained altered rocks were examined and sampled. Rocks with anomalous precious metal concentrations, as identified by previous studies (MacIntyre and Desjardins, 1988b), were re-examined and sampled. Stream-sediment and water samples were collected to supplement the existing Regional Geochemical Survey database for the area.

Field studies also included examination of selected metallic mineral prospects and deposits and general prospecting in areas of favourable geology. During the program three previously undocumented polymetallic vein occurrences were found: these are the Silver King

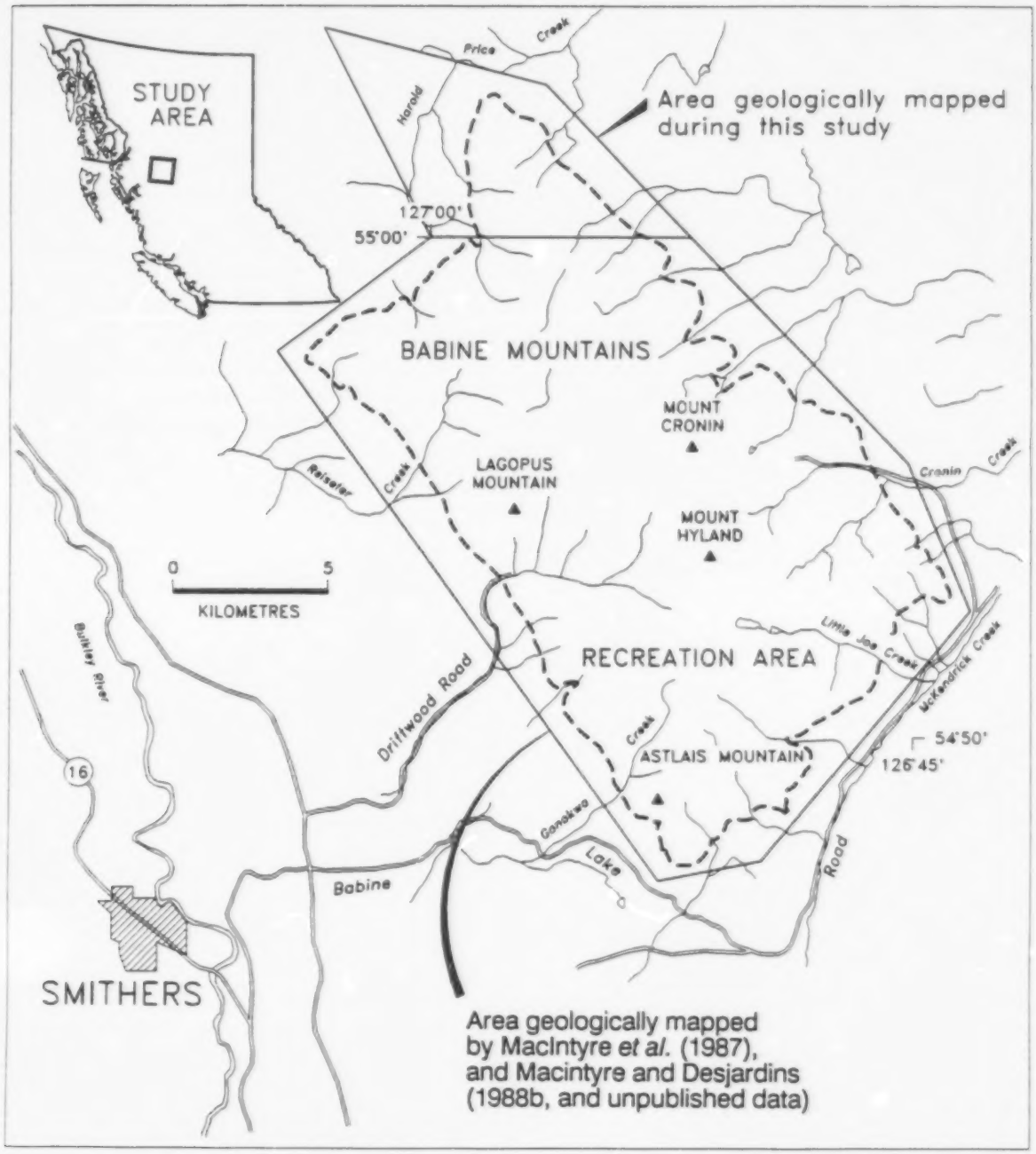


Figure 3. Location of the Babine Mountains Recreation Area (parts of 93L/14E, 15W and 93M/2W), west-central British Columbia.

Lake, Rhyolite and Little Joe Lake South showings. These new showings were mapped in some detail and sampled (Gaba *et al.*, 1992).

## PHYSIOGRAPHY AND ACCESS

The Babine Mountains Recreation Area is within the southernmost part of the Skeena Mountains. The Babine Range includes the discontinuous system of mountains that occupies the area between the confluence of the Babine River with the Skeena River and the confluence of the Morice and Bulkley rivers. The recreation area covers most of the southern part of the Babine Range, sometimes referred to as the Cronin Range. The Telkwa Range of the Hazelton Mountains lies to the southwest, beyond the valley of the Bulkley River; to the east is the Nechako Plateau (Holland, 1964).

The Babine Range has been glaciated and eroded, and incised by creeks that flow east to Babine Lake or west to the Bulkley River, both eventually draining into the Skeena River. Perennial snowfields and glaciers are present at higher elevations, supplying meltwater to alpine lakes and streams. Timberline is at about 1500 metres elevation, below which the slopes are heavily timbered with spruce, balsam and poplar.

The main road into the region is the Yellowhead Highway 16, which follows the Bulkley Valley from Houston through Telkwa, Smithers and north to New Hazelton (Figure 3). The recreation area may be reached from Smithers by means of the Babine Lake road and gravel four-wheel-drive roads, which include the Driftwood Creek, Onion Mountain and Cronin Creek Higgins Creek roads: access to the interior of the recreation area is restricted by gates placed at the boundary. A network of hiking trails crosses the southern part of the area and includes the Silver King basin - Cronin Creek trail and the McCabe/Lyons Creek - Little Joe Creek trail system (Blix, 1977). The northwest part of the recreation area, adjacent to Reiseter Creek, is traversed by the Reiseter Lakes trail, whereas the region to the north and east of Reiseter Lakes has no established trails. Helicopter companies, operating out of Smithers, which hold a valid Resource Use Permit for commercial flights within the recreation area provide charter service to more remote regions.

## ACKNOWLEDGMENTS

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The author also thanks the professional staff of the Geological Survey Branch and in particular M.L. Malott and D.V. Lefebure for information and assistance. Stream-sediment samples were collected by J.L. Gravel of Bonaventure Management Services. T. Brooks and L. Ledoux of Canadian Helicopters in Smithers provided safe and punctual helicopter service during field studies.

Critical reviews of this report by B. Grant, J.M. Newell, G.P. McLaren and W.J. McMillan greatly improved the focus of its content.

# GEOLOGY OF THE BABINE MOUNTAINS RECREATION AREA

The region covered by the Babine Mountains Recreation Area is part of the Stikine Terrane and is underlain by: subaerial to submarine volcanic, volcaniclastic and sedimentary rocks of the Early to Middle Jurassic (*see* Appendix B) Hazelton Group; sedimentary rocks of the Middle to Late Jurassic Bowser Lake Group and Early Cretaceous Skeena Group; and calcalkaline continental volcanic-arc rocks of the Late Cretaceous Kasalka Group. Late Cretaceous to Early Tertiary volcaniclastic rocks occur locally (MacIntyre and Desjardins 1988a). Dikes and stocks of intermediate to felsic igneous rocks are Late Cretaceous to Tertiary in age (Figure 4 in pocket).

## STRATIFIED ROCKS

### Hazelton Group

The Hazelton Group is an assemblage of continental to volcanic island-arc derivation and is divided into four geological formations: the Sinemurian or older Telkwa Formation, the Late Sinemurian to Pliensbachian Nilkitkwa Formation, the Toarcian to Bajocian Eagle Peak formation (informal) and the Middle Toarcian to Early Callovian Smithers Formation (MacIntyre and Desjardins, 1988a, b; Figure 4).

The Telkwa Formation consists of subaerial and submarine pyroclastic rocks and volcanic flows, with minor intercalated sedimentary rocks, and is the thickest and most extensive formation of the Hazelton Group. The Telkwa Formation within the study area comprises dacitic to basaltic flows and pyroclastic rocks, including massive to amygdaloidal basalt. These rocks are conformably to disconformably overlain by shale, siltstone, conglomerate and minor limestone of the Nilkitkwa Formation. Distinctive brick-red to maroon ash, crystal and lapilli tuff and related epiclastic rocks (with subordinate amygdaloidal basalt) of the Eagle Peak formation overlie the Telkwa Formation and part of the Nilkitkwa Formation (to which the Eagle Peak formation was previously assigned). The Smithers Formation includes fossiliferous feldspathic sandstone and siltstone representative of a marine transgressive sequence that onlaps older volcanic rocks: this is seen in the Higgins Creek area where rocks of the Smithers Formation rest disconformably on amygdaloidal basalt flows of the Eagle Peak formation.

### Bowser Lake Group

The Bowser Lake Group is a series of marine to nonmarine sedimentary rocks which conformably overlie the Smithers Formation. Rocks of the Bowser Lake Group within the study area are represented by the Ashman Formation of predominantly Callovian age, the lowermost part of the Bowser Lake Group (MacIntyre and Desjardins, 1988a, b; Figure 4). The Ashman Formation consists of dark grey siltstone and black argillite, with lesser feldspathic and quartzose sandstone: these rocks are generally phyllitic and tightly folded, and in the absence of fossils are correlated on the basis of stratigraphic position and lithology.

### Skeena Group

The Skeena Group is a conformable sequence of Early Cretaceous marine and nonmarine sedimentary and volcanic rocks divided into the Kitsuns Creek, Rocky Ridge and Red Rose formations (informal) (MacIntyre and Desjardins, 1988a, b; Figure 4). These rocks generally do not contain age-diagnostic fossils and are assigned to these formations on the basis of lithology and stratigraphic position. They occur as fault-bounded blocks or as isolated exposures that unconformably overlie Hazelton Group (and possibly Bowser Lake Group) rocks throughout the study area. The Kitsuns Creek formation consists of quartz-pebble and chert-pebble conglomerate, sandstone and shale; these rocks are Neocomian in age if correlation with the type locality is valid. They are overlain by green, red and grey andesitic to basaltic augite-phyric flows and related pyroclastic rocks of the Rocky Ridge formation. Shale, siltstone, micaceous wacke and conglomerate of the Red Rose formation probably sit conformably on volcanic rocks of the Rocky Ridge formation.

### Kasalka Group

Rocks of the Kasalka Group are exposed in the core of the study area and unconformably or structurally overlie the Skeena Group and older rocks; the Kasalka Group is divided into a lower and upper division (MacIntyre and Desjardins, 1988a, b; Figure 4). The lower division (uKK1) includes heterolithic volcanic conglomerate and breccia, volcanic wacke and tuff, feldspar and augite-phyric amygdaloidal and vesicular flows, air-fall lapilli and crystal tuff and associated epiclastic rocks. The upper

division (uKK2) is mainly massive flows of hornblende-feldspar-phyric andesite with related breccias and subvolcanic intrusions: the contact with volcaniclastic rocks of the lower division is not well exposed but is assumed to be conformable. Rocks of the lower division are probably representative of explosive subaerial volcanism and caldera subsidence, with the upper division a subsequent period of lava eruption and volcanic cone development.

### Late Cretaceous to Early Tertiary Rocks

Two fault-bounded panels of bedded tuffaceous and argillaceous rocks northwest of Mount Cronin rest directly on coarse-grained feldspar porphyry (MacIntyre and Desjardins, 1988a, b; Figure 4): the contact is an erosional surface and the rocks appear to have been deposited directly onto the porphyry body. These rocks are thought to be Late Cretaceous or Early Tertiary in age.

## PLUTONIC ROCKS

Igneous intrusions within the study area include rhyolite, diorite and granitic rocks (MacIntyre and Desjardins, 1988a, b; Figure 4). They are considered to be part of a Middle Eocene suite known as the Nanika intrusions (Carter, 1981).

Rhyolite and diorite dikes and plugs cut rocks that fringe the region underlain by Late Cretaceous volcanic rocks of the Kasalka Group, centred on Mount Cronin. Rhyolite spatially associated with polymetallic veins along the east side of the study area (such as those at the Cronin mine and Lorraine and Rhyolite prospects) is quite commonly deformed within enclosing Jurassic rocks, suggesting an older age than rhyolite in the Kasalka Group. Rhyolite north of Lagopus Mountain and east of Mount Cronin cuts foliated Early and Upper Cretaceous rocks and therefore post-dates mid-Cretaceous folding and shearing.

Multiphase intrusions are exposed southeast of Astlais Mountain and include quartz feldspar porphyry, quartz diorite porphyry and diorite.

## STRUCTURAL GEOLOGY

The structural setting of the Babine Range is similar to that of the basin-and-range physiographic province of the southwest United States. The region is dominated by a series of northwest-trending tilted horsts and grabens: blocks are stepped downwards towards the northwest, where progressively younger stratigraphic levels are preserved (MacIntyre and Desjardins, 1988a, b; Figure 4). Structures within the fault blocks are characterized by asymmetric to overturned, southeast-plunging open folds that are truncated mainly by northeast-trending high-angle faults.

The earliest phase of deformation was probably related to regional compression during Late Cretaceous time, accompanied by folding and uplift. Regional extension is thought to have developed during Late Cretaceous to Early Tertiary time, coincident with extensive volcanism and stratovolcano development. Compression during Tertiary time caused reverse movement along pre-existing high-angle normal faults, and resulted in upward thrusting and folding of fault blocks. The latest event seems to be the development of major east to northeast-trending faults, also probably of Tertiary age, that truncate and offset the dominant northwest-trending structural fabric of the range (MacIntyre and Desjardins, 1988a).

The structural configuration of the region northwest of Mount Cronin seems to reflect volcanism that was active during the Late Cretaceous. The arcuate pattern of inward-dipping faults coincident with a network of radiating high-angle normal faults (Figure 4) may have been the result of volcanic eruption, followed by magma chamber evacuation and collapse (*i.e.*, the formation of a collapse caldera). Dikes of diorite and rhyolite that fringe the Late Cretaceous volcanic centre may have been intruded along peripheral ring fractures (MacIntyre and Desjardins, 1988).

# APPRAISAL OF KNOWN MINERAL RESOURCES

## EXPLORATION AND MINING: PAST AND PRESENT

Exploration for base and precious metals in the Babine Range has been ongoing since the turn of the century (Appendix C). Early efforts were focussed mainly on high-grade silver-rich veins. The construction of the Grand Trunk Pacific Railway up the Bulkley valley (1910-1914) provided the essential link to economically transport the metal ores to market. Horse trails or rough roads were built to the most promising prospects, and high-grade metal ores were packed out to the railway at Telkwa and shipped mainly to the smelter at Trail.

By 1950 many of the high-grade deposits had been worked on a small scale and had produced modest quantities of direct-shipping base and precious metal ores (Table 2). At about this time, a concentrator was built at the Cronin mine: lead and zinc concentrates (also containing considerable gold, silver, copper and cadmium) were shipped to Trail, and continued almost every year until it closed in 1974 (Table 2). Mineralized material remains underground at the Cronin mine and estimates have been made regarding the quantity present and its metal content (Table 3).

The early 1960s saw a resurgence of exploration interest focussed primarily on porphyry copper-molybdenum properties, particularly the Big Onion prospect. Considerable work has been done on this property, and important copper, molybdenum and precious metal resources have been identified (Table 3).

Mineral exploration interest remains high. Much of the recreation area is covered by mineral claims in good standing (as of September 25, 1991) over all of the known mineral prospects and deposits (Figure 5): most of these claims pre-date the establishment of the recreation area. Mineral claim types include: Crown grants, reverted Crown grants, 2-post and 4-post (modified grid system) claims recorded before the *Mineral Tenure Act* of 1988 was enacted, and 1-post claims subsequent to the Act. The recreation area is presently open to 1-post claim staking; mineral exploration requires a permit, with conditions jointly set by the Ministries of Energy, Mines and Petroleum Resources, and Environment, Lands and Parks.

## MINERAL DEPOSIT TYPES

There are three distinct types of mineral deposits within the Babine Mountains Recreation Area: porphyry copper-molybdenum deposits associated with quartz-feldspar porphyry and quartz-diorite porphyry intrusions, silver-rich polymetallic veins and basalt-hosted copper-silver veins (Table 4). Certain rocks within the study area have the potential to host polymetallic massive sulphide mineralization, as at the Ascot prospect (MINFILE 093L 024) 6 kilometres southeast of the recreation area. There is no known occurrence of polymetallic massive sulphide within the study area, but it is nevertheless considered an important deposit type for evaluation of mineral resource potential (Table 4).

The majority of mineral occurrences within the recreation area are silver-rich polymetallic veins (Table 5), seven of which are past producers and form a belt across the central part of the study area (Figure 6). Basalt-hosted copper-silver veins cluster mainly in the southwest, whereas porphyry copper-molybdenum prospects are almost exclusively in the south. The northern part of the recreation area is almost completely devoid of mineral occurrences (Figure 6).

Detailed geological descriptions (including production and exploration histories) of all mineral prospects within the Babine Mountains Recreation Area are included in the Ministry of Energy, Mines and Petroleum Resources computerized mineral inventory database (MINFILE) for the Smithers map sheet (NTS 093L). These data are available in hard-copy print-outs or in digital format (standard ASCII format files) on 5 inch floppy diskettes, from Crown Publications Incorporated, Victoria, B.C.

### Porphyry Copper-Molybdenum Deposits

Although porphyry copper-molybdenum deposits have not been historically important within the study area, they are the most promising mineral deposit type presently being evaluated.

#### THE BIG ONION DEPOSIT

The Big Onion prospect, a low-grade large-tonnage calcalkaline porphyry copper-molybdenum deposit, straddles the southern boundary of the recreation area on the south side of Astlais Mountain, 18 kilometres east of Smithers (Figure 6). The property is reached by the Bab-

## TABLE 2
## HISTORICAL METAL PRODUCTION FROM THE BABINE MOUNTAINS RECREATION AREA*

| DEPOSIT TYPE | MINFILE # (093L) | PROPERTY NAME | PERIOD OF PRODUCTION | ORE MINED (TONNES) | GOLD (grams) | SILVER (grams) | COPPER (kg) | LEAD (kg) | ZINC (kg) | CADMIUM (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| | 125 | Silver Pick | 1927, 1936, 1938 | 23 | 466 | 209 230 | 886 | 420 | 836 | |
| Silver-Rich Polymetallic Veins | 127 | Cronin | 1917, 1929, 1951-74 | 25 838 | 8 772 | 8 169 918 | 10 394 | 1 347 178 | 1 517 881 | 18 012 |
| | 128 | Hyland Basin | 1935, 1940 | 10 | 342 | 84 880 | | 3 396 | 397 | |
| | 129 | Lorraine | 1917 | 6.4 | | 19 448 | | 3 175 | | |
| | 201 | Silver King | 1917, 1927 | 12 | 62 | 41 865 | 107 | 3 490 | 348 | |
| Basalt-Hosted Cu-Ag Veins | 131 | Drift | 1915-18, 1927, 1971 | 23 | | 132 779 | 4 711 | | | |
| | 132 | Driftwood | 1937, 1969 | 9 | 93 | 21 928 | 109 | 327 | 245 | |
| TOTAL | | | | 25 931.4 | 9 735 | 8 680 048 | 16 287 | 1 377 986 | 1 519 707 | 18 012 |

*For details concerning past production *see* Appendix C

## TABLE 3
## ESTIMATES OF METAL RESOURCES WITHIN THE BABINE MOUNTAINS RECREATION AREA

| DEPOSIT TYPE | MINFILE # (093L) | PROPERTY NAME | ESTIMATED RESOURCE TONNAGE | GOLD (g/t) | SILVER (g/t) | COPPER (%) | LEAD (%) | ZINC (%) | MOLYBDENUM (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 34 790 000 t (indicated)[1] | | | | | | |
| | | | 59 624 000 t (inferred)[1] | | | | | | |
| Porphyry Cu-Mo | 124 | Big Onion | 94 414 000 t (total) | | | 0.42 | | | 0.012 |
| | | | 31 760 000 t (supergene only)[2] | 0.044[3] | 1.0[3] | 0.34[4] | | | |
| Silver-Rich Polymetallic | 127 | Cronin | 47 210 t (unclassified)[5] | 1.7 | 428 | 0.16 | 8.0 | 8.0 | |

[1]Calculations by Stock (1977a)
[2]Estimate of supergene mineralization by McCrossan (1991), being part of the total resource estimate as calculated by Stock (1977a)
[3]Average precious metal content of supergene mineralization (McCrossan, 1991)
[4]A cut-off grade of 0.15 per cent total copper was used in the calculation of the supergene mineralization estimate (McCrossan, 1991)
[5]From Melville et al.,(1992)

## TABLE 4
## IMPORTANT MINERAL DEPOSIT TYPES WITHIN AND ADJACENT TO THE BABINE MOUNTAINS RECREATION AREA

| SYMBOL[1] | DEPOSIT TYPE | METAL ASSEMBLAGE | METALLIC MINERALS | TEXTURES AND STRUCTURES | HOSTROCKS | ALTERATION |
|---|---|---|---|---|---|---|
| ●○ | Porphyry Cu-Mo | Cu, Mo; (Au, Ag) | cpy, mo, py, cc, cv | stockwork, breccia, veins, disseminations | quartz feldspar porphyry (qfp); quartz diorite porphyry (qdp); diorite (dr) | sericitic, propylitic, silicic, argillic |
| ■□ | Silver-Rich Polymetallic Veins | Ag, (Au), Pb, Zn; Cd, Cu, (As, Sb) | py, sp, gn, cpy, boul, tet; apy, frei, po, (native Au) | simple to complex multiphase quartz-sulphide veins; massive veins; breccia zones; fracture fillings; replacements; disseminations | rhyolite porphyry, dacite (rh); argillite, phyllite (muJA); andesite porphyry (uKK1, uKK2) | silicic |
| ▲△ | Basalt-Hosted Cu-Ag Veins | Cu, Ag, (Au), Pb, Zn | cpy, born, tet; cc, cv, mal, az (sp, gn) | sheeted quartz veins; silicified zones; breccia zones; disseminations; stockwork | amygdaloidal basalt, basaltic tuff, basaltic andesite, volcanic breccia (lJT, lJTb) | propylitic, argillic |
| N/A | Polymetallic Massive Sulphides[2] | In, Pb, Ba, Cu; As | py, sp, gn, ba; tet | strata-bound massive lenses; disseminations; fracture fillings | limy siltstone, felsic tuff; argillite (lJN); amygdaloidal basalt (lJT, lJTb) | |

[1]Different deposit types are represented by symbols on Figure 4
[2]Although there are no known polymetallic massive sulphide prospects within the Babine Mountains Recreation Area, this deposit type occurs only 5 kilometres southwest of the study area in similar stratigraphy and is an important mineral deposit type to consider for a complete understanding of the mineral resource potential of the region.

Abbreviations: apy = arsenopyrite, az = azurite, ba = barite, born = bornite, boul = boulangerite, cc = chalcocite, cpy = chalcopyrite, cv = covellite, frei = freibergite, gn = galena, mal = malachite, mo = molybdenite, po = pyrrhotite, py = pyrite, sp = sphalerite, tet = tetrahedrite.

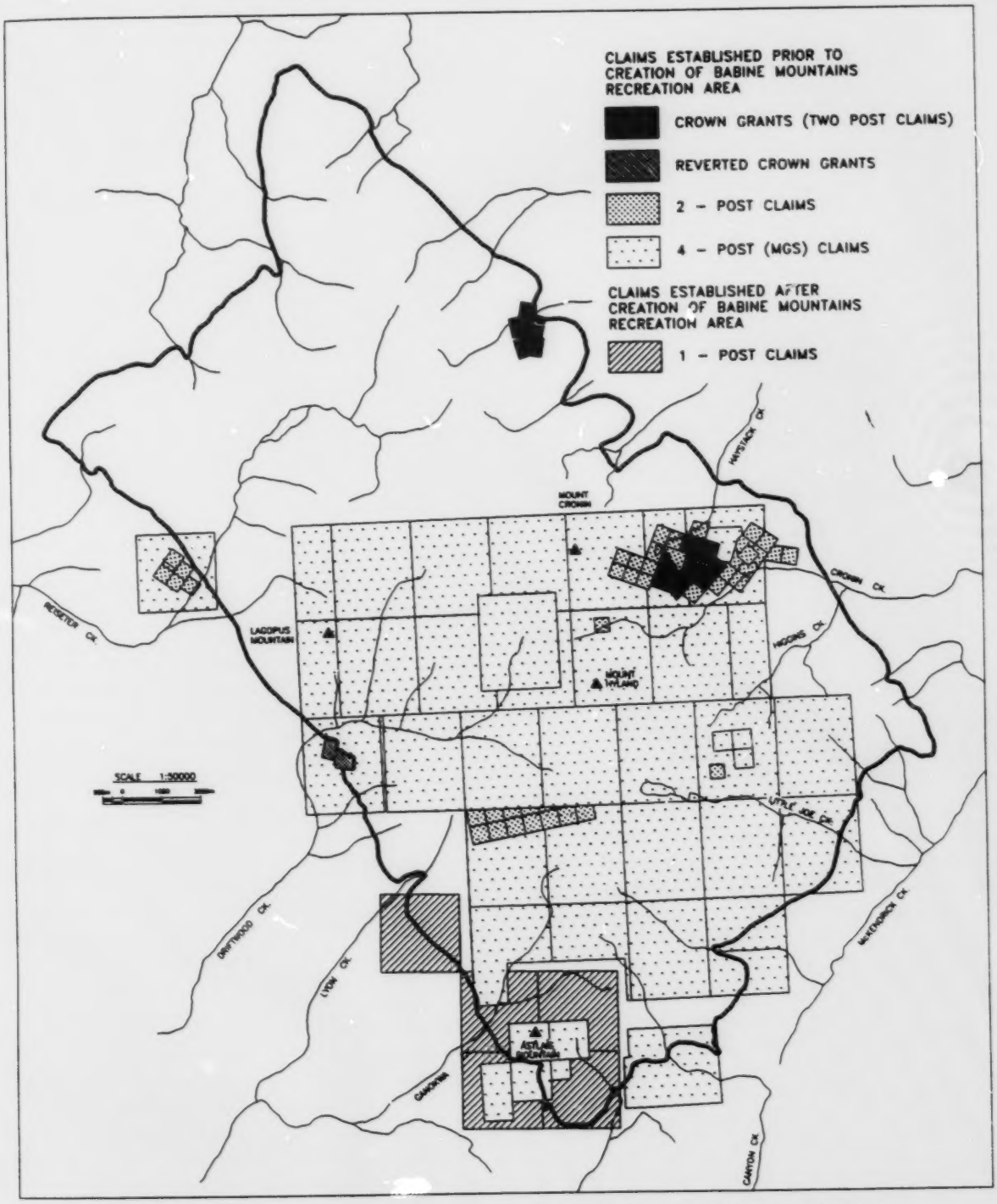



Figure 5. Mineral tenure in the Babine Mountains Recreation Area (as of September 25, 1991).

TABLE 5
KNOWN METALLIC MINERAL OCCURRENCES WITHIN THE BABINE MOUNTAINS RECREATION AREA

| DEPOSIT TYPE | MINFILE # (093L) | PROPERTY NAME | COMMODITIES | PROPERTY STATUS |
|---|---|---|---|---|
| Porphyry Cu-Mo | 124 | Big Onion | Cu,Mo,[Au,Ag] | developed prospect |
| | 126 | Mert | Cu,Mo,[Ag] | showing |
| | 252 | Fisher | Cu | showing |
| Silver-Rich Polymetallic Veins | 125 | Silver Pick | Ag,[Au],Cu,Zn;Pb | past producer |
| | 127 | Cronin | Ag,[Au],Pb,Zn;Cd,Cu | past producer |
| | 127A | Upper Showing | Ag,[Au],Pb,Zn;Cd,Cu | showing |
| | 128 | Hyland Basin | Ag,[Au],Pb;Zn | past producer |
| | 129 | Lorraine | Ag,Pb;Zn,Cu | past producer |
| | 138 | AG | Ag,Pb;Zn | showing |
| | 139 | Reiseter Creek | Cu,Pb;Zn | showing |
| | 140 | Debenture | Ag,Pb,Zn | prospect |
| | 200 | Silver Saddle | Ag,Au,Pb;Cu | showing |
| | 201 | Silver King | Ag,[Au],Pb;Zn,Cu | past producer |
| | 249 | Native | Ag,Pb,Zn | showing |
| | 316 | Silver King Lake | Ag,[Au],Pb,Cu,Zn;Cd | showing |
| | 317 | Rhyolite | Au,Ag,Cu;Pb,Zn,Cd | showing |
| | 318 | Little Joe Lake South | Ag,[Au],Pb,Zn;Cu,Sb | showing |
| Basalt-Hosted Cu-Ag Veins | 130 | Jud | Cu,Ag | showing |
| | 131 | Drift | Cu,Ag;Pb | past producer |
| | 132 | Driftwood | Ag,[Au],Cu,Pb,Zn | past producer |
| | 165 | Shamrock | Ag,Cu | showing |
| | 253 | Home | Ag;Cu,Pb,Zn | showing |
| Unclassified | 292 | Viking | [Ag,Au] | showing |

ine Lake road and a network of four-wheel-drive roads (established during the 1960s diamond drilling programs) that zig-zag up the creek valley to the mountain. The main zones of copper and molybdenum mineralization are within the creek valley between 1065 and 1675 metres elevation, with the bulk of the deposit below treeline (approximately 1460 metres elevation).

### Exploration History

The history of exploration at the Big Onion property spans almost 75 years, and includes the efforts of many individuals and exploration firms. The following historical account is extracted from *B.C. Minister of Mines* Annual Reports (various years), Hanson (1925), Sutherland Brown (1967), L'Orsa (1990) and McCrossan (1991).

The original copper showings at the Big Onion were found by local prospector Axel Elmsted and his partners Tommy Haig and Ben Benson in 1917 and were staked as the Cimbria group the following year: they named the nearby iron-stained mountain the Big Onion (now called Astlais Mountain) in allusion to them "peeling the onion", or striking it rich. By 1924, a small camp had been built and two short adits were driven into the mountain side: a lower adit 50 metres long at 1150 metres elevation, and an upper adit 15 metres long at 1170 metres elevation. Mineralization exposed by the adits consisted of disseminated pyrite, chalcopyrite and malachite, with small gash veinlets containing quartz, pyrite, chalcopyrite and specularite. Analyses of samples returned small quantities of copper and traces of gold. Further exploratory work was done on the property by A. Elmsted and B. Mueller up to 1932.

The property remained dormant until 1964 when Jack Helmspeck Sr. restaked the property and optioned it to Noranda Exploration Company Limited. During 1964 and 1965, Noranda carried out mapping and geochemical sampling programs, electromagnetic surveys, bulldozer stripping and 76 metres of diamond drilling in two holes before dropping the option.

In 1965, the Texas Gulf Sulphur Company optioned the property and during 1966 and 1967 completed detailed geological, geochemical, and induced polarization and resistivity surveys, more than 900 metres of bulldozer stripping, and 1217 metres of diamond drilling in seven holes. During this period, claims to the east of the Big Onion (to be later known as the Mert property) were staked by Tro-Buttle Exploration Limited and soil geochemical surveys were conducted as part of the exploration for copper and molybdenum mineralization. The mid-1960s was also a time when many other major exploration companies were busy exploring for porphyry copper in the area: results of these efforts include the discovery of the Bell Copper deposit, as well as other important prospects in the Babine Lake area.

In 1970 and 1971, Blue Rock Mining Corporation Limited/Cyprus Anvil Mining Corporation obtained an option on the Big Onion property and completed 7358 metres of diamond drilling in twenty-two holes.

From 1974 to 1977, Canadian Superior Exploration Limited conducted geological and geophysical surveys on the Big Onion claims and drilled 5003 metres in 67 per-

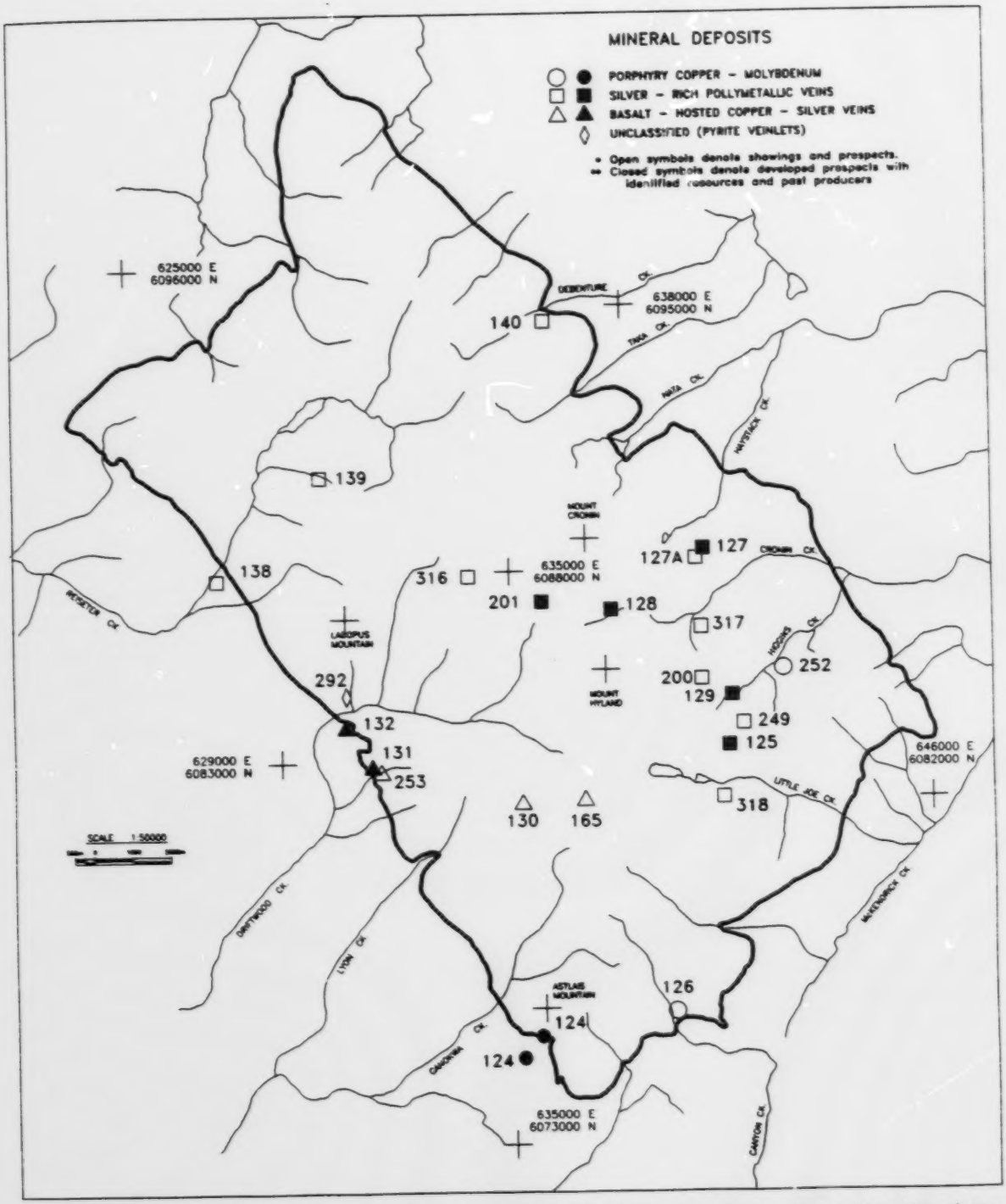



Figure 6. Distribution of mineral occurrences in the Babine Mountains Recreation Area according to mineral deposit type (*see* Table 4): open symbols designate showings or prospects, closed symbols designate developed prospects with identified resources or past producers.

cussion holes and 3058 metres in 21 diamond drill holes. In 1982, the property reverted back to Jack Helmspeck Jr.

Mindoro Corporation optioned the Big Onion property from Jack Helmspeck Jr. in 1990 and Varitech Resources Limited acquired an interest in the property early in 1991. The 1991 diamond drilling program by Varitech consisted of eight holes totalling 1696 metres, and outlined the extent of the supergene (or secondary enrichment) zone as well as the depth of hypogene (or primary) mineralization (McCrossan, 1991).

### Geology and Mineralization

Early descriptions of the geology of the Big Onion property include those by Sutherland Brown (1967) and Schroeter (1977a). Mineralization is associated with an irregular northeast-trending stock of quartz-feldspar porphyry (with a core of quartz-diorite porphyry) that intrudes amygdaloidal basalt of the Early Jurassic Telkwa Formation and sedimentary rocks of the Early Jurassic Nilkitkwa Formation (Figure 4). A post-mineralization dike of quartz monzonite porphyry cuts the plutonic rocks southwest of the main concentration of metals: biotite extracted from this dike gave a potassium-argon isotopic age of 48.7±1.9 million years, or an Eocene age (Carter, 1981). The host intrusions of the Big Onion deposit appear to have been emplaced along a northeast-trending fault, subsequently transected and offset by northwest-trending structures (Figure 4): the quartz monzonite porphyry dike appears to occupy late north-trending structure.

Hypogene mineralization consists of disseminated and fracture-controlled chalcopyrite and molybdenite, associated mostly with altered quartz-feldspar porphyry but also with the margins of the altered quartz-diorite porphyry and adjacent altered basalt. Supergene mineralization, most important in the north part of the deposit, consists of chalcocite and covellite, with subordinate bornite and rare native copper (Stock, 1977a; McCrossan, 1991).

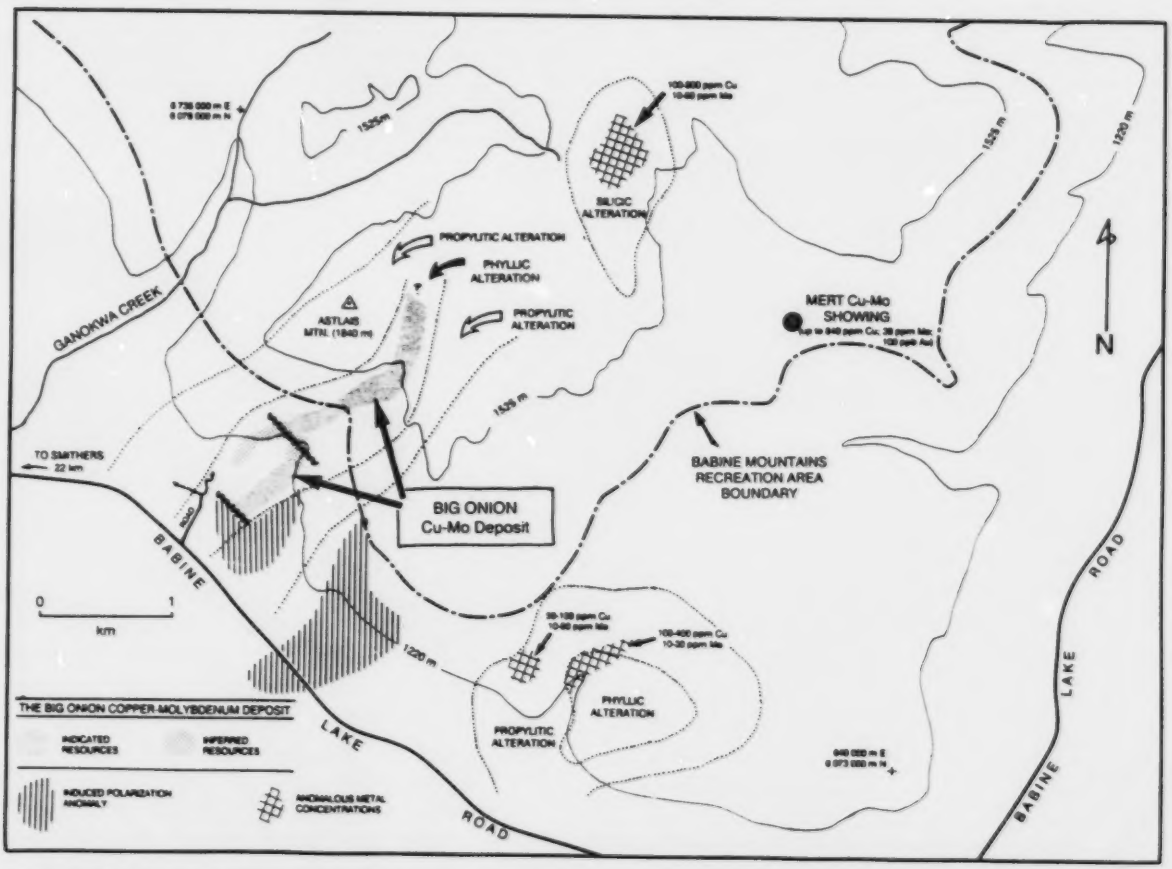



Figure 7. The southern part of the Babine Mountains Recreation Area; distribution of metal resources and alteration at the Big Onion deposit, geophysical anomalies adjacent to the deposit, and anomalous metal concentrations associated with alteration zones nearby [compiled from Depaoli (1977), Stock (1977b) and McCrossan (1991)].

Hostrocks to the metal concentrations, as well as adjacent country rocks, are hydrothermally altered: mineralization is coincident with a phyllic alteration zone characterized by sericite and local quartz stockwork. Propylitic-altered rocks, defined by epidote-calcite-chlorite alteration mineral assemblages fringe the phyllic zone (Figure 7; Stock, 1977a). Pyrite is ubiquitous within and adjacent to the deposit and locally reaches concentrations of 10 per cent. A natural process, oxidation of the pyrite by near-surface groundwater, produces sulphuric acid which tends to acidify streams that drain the valley and leach metals from rocks above the groundwater table. Metals deposited from these solutions have enriched the mineralization just below the groundwater table and have formed the supergene enrichment zones.

#### Identified Metal Resources and Potential Exploration Targets

In 1977, Canadian Superior calculated a potential resource estimate utilizing 16 707 metres of combined percussion and diamond drill data from the Big Onion deposit (Stock, 1977a; Table 3). Recent work by Varitech has outlined the extent of supergene mineralization and its average gold and silver contents (McCrossan, 1991; Table 3). At present metal prices, the gross dollar value of metal in-the-ground at the Big Onion deposit is estimated at more than $1.1 billion (Appendix A).

Indicated metal resources at the Big Onion deposit are elongate zones that trend northeast coincident with the local structural setting (Figure 7). The apparent dislocation of the two main zones is probably due to late faulting: the area adjacent to the offset contains inferred resources and requires further evaluation to confirm the presence of economic metal concentrations (Figure 7). A northeast extension to the indicated resources has not been explored: silicic altered rocks 1.5 kilometres farther to the northeast with up to 800 ppm copper and 80 ppm molybdenum suggests excellent potential for additional metals along strike of the deposit.

The southwestern extension of the deposit appears to have been truncated or offset by a fault. Because of the lack of exposed rock and the extensive overburden, geophysical techniques, such as induced polarization (I.P.) surveys, have been conducted in the search for a possible extension to the Big Onion deposit, or additional similar mineralization (Figure 7). The I.P. anomalies south of the Big Onion deposit are interpreted to indicate the presence of sulphide mineral concentrations at depth (Depaoli, 1977). These anomalies are considered to be viable exploration targets, but have not yet been tested by diamond drilling.

Porphyry copper-molybdenum mineralization also occurs at the Mert showing, three kilometres northeast of the Big Onion property (Figure 7). Amygdaloidal basalt of the Telkwa Formation is intruded by a small, elongate stock of quartz diorite which contains minor chalcopyrite, pyrite and molybdenite in hairline fractures and quartz veinlets (Guardia, 1970). Anomalous concentrations of copper and molybdenum were first identified by soil and rock geochemical surveys conducted on the claims in 1967 and 1968 by Tro-Buttle Exploration Limited: rock chip samples contain up to 840 ppm copper, 38 ppm molybdenum and 100 ppb gold (Dirom, 1969). A follow-up magnetometer survey by Tro-Buttle in 1970 suggested that the quartz diorite is much more extensive beneath the overburden than previously thought. However, the quartz diorite has not been tested by diamond drilling. The similarity in geological setting and character of the Big Onion and Mert prospects are apparent: any correlation between the two properties, however, is hindered by the lack of outcrop in the intervening area.

The large diorite body south of the Mert property and southeast of the Big Onion property (Figure 4) has a central core of phyllic altered rocks surrounded by propylitic altered rocks (Figure 7; Stock, 1977b). Rock geochemical surveys by Canadian Superior Exploration Limited revealed the presence of up to 400 ppm copper and 80 ppm molybdenum at several locations within the altered zones, but no follow-up work was done.

The potential for additional porphyry copper-molybdenum mineralization within the southern part of the Babine Mountains Recreation Area (between the Big Onion and Mert properties and the large diorite stock) is high (Figure 7): additional geological and geophysical exploration is required to test this poorly-exposed area for concealed metal resources.

### Silver-Rich Polymetallic Veins

Most of the metal production in the study area has come from silver-rich polymetallic veins (Tables 2, 5), with the Cronin being the only deposit large enough to warrant its own milling facilities. Silver-rich polymetallic veins are mineralogically complex and consist usually of two or more base metal sulphide and sulphosalt minerals in a quartz (±carbonate) gangue (Table 4). Metals sought were primarily silver (contained as a component in some of the metallic minerals), with significant gold, lead, zinc, copper and cadmium.

These veins are commonly discordant to hostrocks, irregular in attitude and continuity, and pinch and swell along their length. These characteristics make economic assessment difficult without underground exploration. In the early days of mining, adits and drifts were driven along the veins, and small orebodies were encountered where the veins swelled to greater thicknesses.

#### THE CRONIN MINE

The Cronin mine is on the east flank of Mount Cronin, approximately 28 kilometres northeast of Smithers (Figures 4 and 6). The property is reached by the Babine Lake road and a narrow rough road up the valley of

Cronin Creek. The Cronin mine was the most significant producer of metals in the study area (Table 2). The extensive polymetallic vein system was developed over 60 years by workings that extend more than 170 metres vertically and about 220 metres laterally: development on three levels totals about 1160 metres of drifts and crosscuts and 365 metres of raises (Livgard, 1973).

### Exploration and Development History

The Cronin deposit was the first important discovery in the southern Babine Range and drew much attention to the region. Its history of exploration and development is drawn from several sources, including *B.C. Minister of Mines* Annual Reports (various years), Quin (1987) and L'Orsa (1990).

The Dibble showing (later to become known as the Babine Bonanza, or Cronin property) was discovered in 1905 by prospectors from Hazelton. In 1909, the claims were acquired by James Cronin and associates, and between 1910 and 1911 extensive underground exploration was carried out. Trails soon linked the property with Telkwa, Morricetown and the Hudson's Bay Company ranch on Driftwood Creek. Underground exploration resumed in 1914 and continued each summer until 1925, with small amounts of hand-cobbed ore shipped to Telkwa in winter by way of a newly-built sleigh road. The untimely death of James Cronin in 1925 postponed plans of constructing a mill at the mine site, and it was not until 1928 that the property was obtained from Cronin's estate by Babine Bonanza Metals Limited and work continued. By late 1931, conditions brought about by the depression halted further work.

Cronin-Babine Mines Limited was formed in 1948 and surface and underground diamond drilling was done. By 1951, a new road was constructed between the property and the Babine Lake road, and a small shipment of ore was made. The following year a 36 tonne-per-day mill was installed at the mine: 3185 tonnes of ore were processed and concentrate (containing silver, gold, lead, zinc, copper and cadmium) was shipped to the Trail smelter, but low metal prices forced the operations to close by the year's end. Work resumed in 1956 and 1957, and metal concentrates continued to be sent to Trail.

In 1958, the Cronin mine was leased from Cronin-Babine mines by Paul Kindrat: he eventually purchased the mine in 1970. Kindrat Mines Limited was truly a family operation, consisting of Paul as miner, and his wife Alice and kids in charge of the mill. The Kindrats made a living at the mine (and raised a family at the same time) making yearly shipments of metal concentrate to Trail until 1972 when the mine was sold to Hallmark Resources Limited.

Between 1973 and 1974, Hallmark Resources Limited refurbished the mill and camp, constructed a tailings disposal area, carried out underground and surface exploration (exposing the new Upper showing, or Wardell zone), mined and milled ore, and shipped metal concentrate. In 1975, the property was optioned to Coca Minerals Limited who conducted a diamond drilling program to assess the relationship of the Upper showing to the Cronin deposit and assess its open-pit potential. Additional diamond drilling was done in 1983 by Goldsil Mining and Milling Incorporated. Most recently in 1987, Southern Gold Resources Limited acquired an option on the property and carried out geological mapping and sampling over the whole property. The property has since been dormant.

### Geology and Mineralization

The Cronin deposit consists of an array of polymetallic veins within a multiphase rhyolite rhyolite-porphyry plug or dome that has irregular borders into surrounding argillite, sandstone, conglomerate and sericite schist of the Middle to Late Jurassic Ashman Formation (Figure 4; Schroeter, 1977b). Several styles of mineralization comprise the deposit and include quartz-sulphide veins, massive sulphide veins, breccia zones, fracture fillings and disseminations. Metallic minerals are mostly sphalerite and galena, with pyrite, chalcopyrite, boulangerite, freibergite, tetrahedrite and arsenopyrite (Livgard, 1973). The major veins strike northeast and dip approximately 50 degrees to the northwest: some are up to 0.6 metres thick and continuous for as much as 75 metres along strike. Most of the veins are in a zone closely adjacent to the northwest margin of the rhyolite complex and many of the more productive veins are at the rhyolite-shale contact (Quin, 1987).

Similar mineralization has been exposed on surface on the Homestake claim to the southwest of the Cronin workings: this showing, known as the Upper showing (or Wardell vein), is regarded as part of the Cronin vein system. The Upper showing vein is 3 metres thick along a strike length of 95 metres (Livgard, 1973). In 1975, a surface diamond-drilling program designed to test the open-pit potential of the Upper showing (and presumably extensions of veins from the Cronin workings) succeeded in identifying a small high-grade deposit, but no large tonnage was outlined (Quin, 1987).

### Identified Metal Resources

Several tonnage and grade estimates have been made of metal resources that remain underground within the Cronin mine and near surface at the Upper showing: these are tabulated by Quin (1987) but contain no indication as to how the calculations were done. The most reliable estimate at this time comes from data collected by MINFILE and the Smithers District Office (Melville *et al.*, 1992) as shown in Table 3. The resource estimate is based, to a large extent, on the amount of "mineable leavings" (McKinstry, 1948) that remain underground from previous operations. Assuming the resource esti-

mate is accurate, the gross dollar value of metals in the ground at the Cronin deposit and Upper showing is estimated at more than $13 million (Appendix A).

## Basalt-Hosted Copper-Silver Veins

Less productive although historically important mineral deposits are the basalt-hosted copper-silver veins (Table 4). These deposits, though generally small, are very rich in silver and copper (Table 2). Mineralization consists of irregular sheeted quartz veins, stringer zones and breccias, within amygdaloidal basalt and flow-top breccia of the Lower Jurassic Telkwa Formation. The veins contain an abundance of copper and silver-bearing sulphide and sulphosalt minerals as high grade pods and fracture fillings.

Basalt-hosted copper-silver veins are almost exclusively confined to rocks of the Telkwa Formation and may be informally referred to as stratabound deposits: they are likely products of late-stage volcanic-hydrothermal activity. Small copper-silver vein showings of this type are relatively abundant throughout rocks of the Telkwa Formation in the Telkwa and Babine ranges (D.G. MacIntyre, personal communication, 1991).

## Polymetallic Massive Sulphide Deposits

As previously stated, there are no known polymetallic massive sulphide occurrences within the Babine Mountain Recreation Area, but is an important deposit type to consider for resource evaluation. Southeast of the study area at the Ascot prospect (MINFILE 093L 024), polymetallic massive sulphides are hosted by limy siltstone and felsic tuff of the Lower Jurassic Nilkitkwa Formation (MacIntyre *et al.*, 1987). The sulphide concentrations, which contain abundant base metals but only a trace of precious metals, occur as massive lenses to disseminations within the sedimentary rocks close to the underlying Early Jurassic Telkwa Formation basalts. The stratabound nature of the deposit and its proximity to volcanic rocks are characteristic of volcanogenic massive sulphide deposits. Comparable rock sequences, present within the study area (Figure 4), might also host similar metal concentrations.

# POTENTIAL FOR UNDISCOVERED MINERAL RESOURCES

## GENERAL STATEMENT

The field-based component of this study gathered information to help assess the potential for undiscovered mineral resources within the recreation area: the data collected augment that from previous studies (MacIntyre *et al.*, 1987; MacIntyre and Desjardins, 1988a, b). Although the region has been prospected and explored during the past 90 years, there is still the possibility that some mineral wealth has escaped detection. The goal here is to identify areas with significant mineral potential to ensure that the region is adequately tested before it is considered for reclassification as park land with no mineral exploration allowed.

The methods used in the field to identify areas of potential exploration interest include: geological mapping; lithogeochemical (rock-chip) sampling of almost all rock types represented in the study area, including zones of altered rocks; stream-sediment sampling; and prospecting of regions deemed favourable for mineral deposits based on information gathered from previously published literature, observations in the field, and personal communication with persons engaged or previously engaged in geological fieldwork in the area. Previously published data from geophysical surveys completed in the study area were also examined.

## GEOLOGICAL MAPPING

The purpose of geological mapping is not only to document the nature, distribution and stratigraphic order of rocks, as well as their structural configuration, but also to evaluate their relationship to the various mineral resources they contain. In this way, areas of favourable geology for any particular mineral deposit type are outlined with reasonable confidence.

This project was fortunate to have access to recent data and maps, produced by a 1:20 000-scale geological mapping program that covered most of the study area (MacIntyre and Desjardins, 1988a, b and unpublished data). Geological mapping during the present study was limited to the northern part of the recreation area which was outside the area covered by the previous mapping program.

## LITHOGEOCHEMICAL SAMPLING

A total of 239 rock samples was collected from the study area during previous (MacIntyre and Desjardins 1988a, b and unpublished data) and present investigations (Figure 8). These samples were analyzed for gold, silver, copper, lead, zinc, molybdenum, cadmium, arsenic and antimony (Appendix D). The database is augmented by lithogeochemical data from assessment work done by Canadian Superior Exploration Limited in the area of the Big Onion property (Stock, 1977b).

More than half the samples collected during this study were from regionally extensive pyritic and limonite-stained altered rocks that form spectacular red-brown gossans across the central part of the study area (Figure 9). These zones are essentially bleached sericitic schists and phyllites derived from volcanic and sedimentary rocks of the Late Cretaceous Kasalka Group. The rocks contain abundant disseminated pyrite, much of which has altered to limonite: oxidation of the pyrite to produce sulphuric acid has probably leached much of the original metal content from the rock. The rocks also exhibit breccia textures and are locally veined by quartz and epidote. The alteration zones, which are a few hundred metres thick, are semicontinuous for several kilometres along a west-northwest strike. They are coincident with shear zones of probable Late Cretaceous age that are truncated by northeast-trending Tertiary faults (Figure 4).

Most of the samples taken from the pyritic and limonite-stained altered rocks contain only background levels of base and precious metals. However, a previously undocumented polymetallic vein (the Silver King Lake prospect: Figure 6, Table 5) was found during the course of sampling (Gaba *et al.*, 1992). In addition, twelve samples contain anomalous metal concentrations (considered to be anomalous by visual inspection of the complete lithogeochemical database) indicative of silver-rich polymetallic veins (Appendix D). Further examination of smaller alteration zones of this type to the east resulted in the discovery of other polymetallic veins at the Little Joe Lake South prospect (Figure 6, Table 5; Gaba *et al.*, 1992). Thus, the sampling program confirmed the presence of at least scattered base and precious metal concentrations within the altered rocks. The altered rocks have not been tested at depth by diamond drilling and

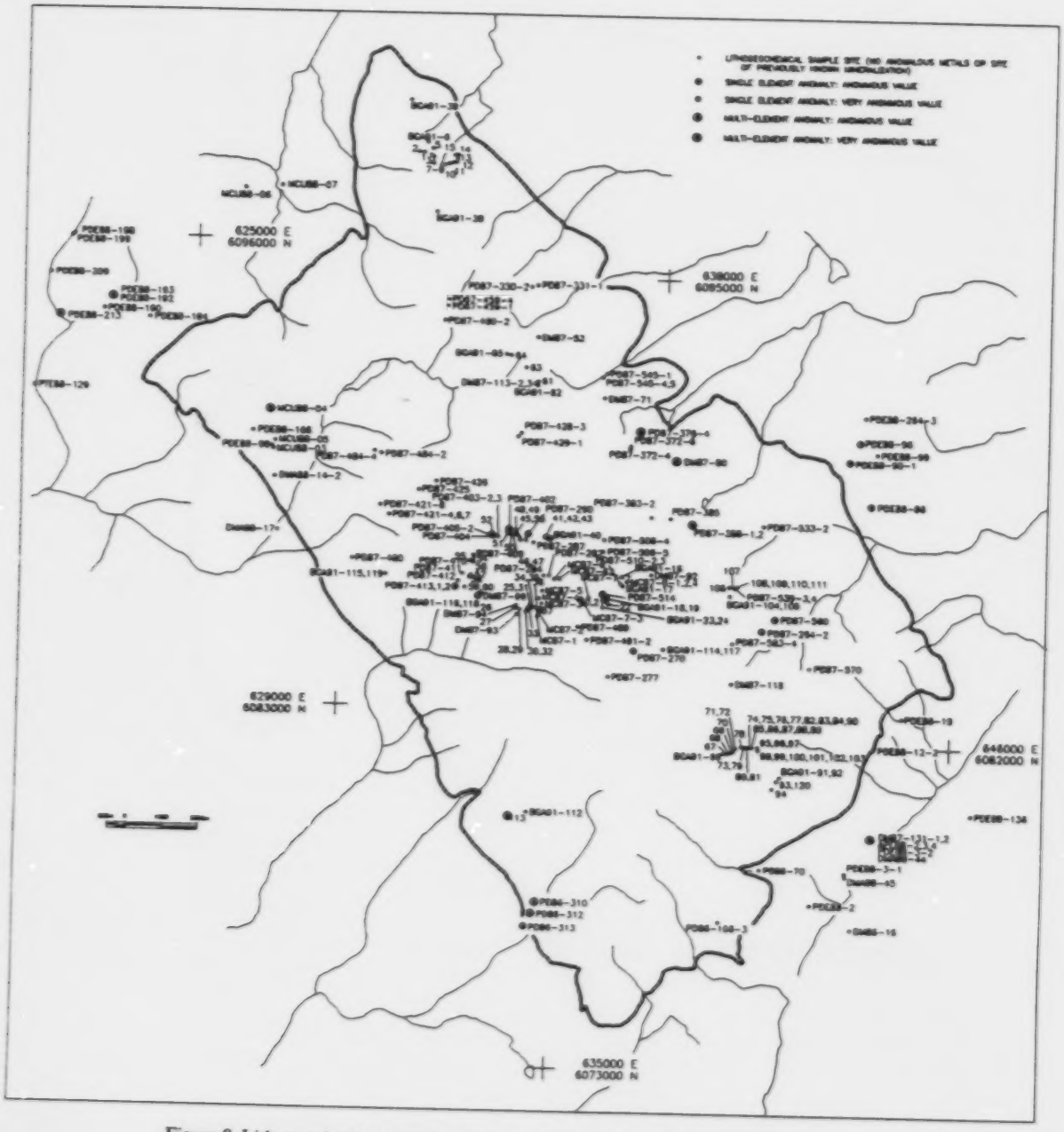



Figure 8. Lithogeochemical sample sites in the Babine Mountains Recreation Area.

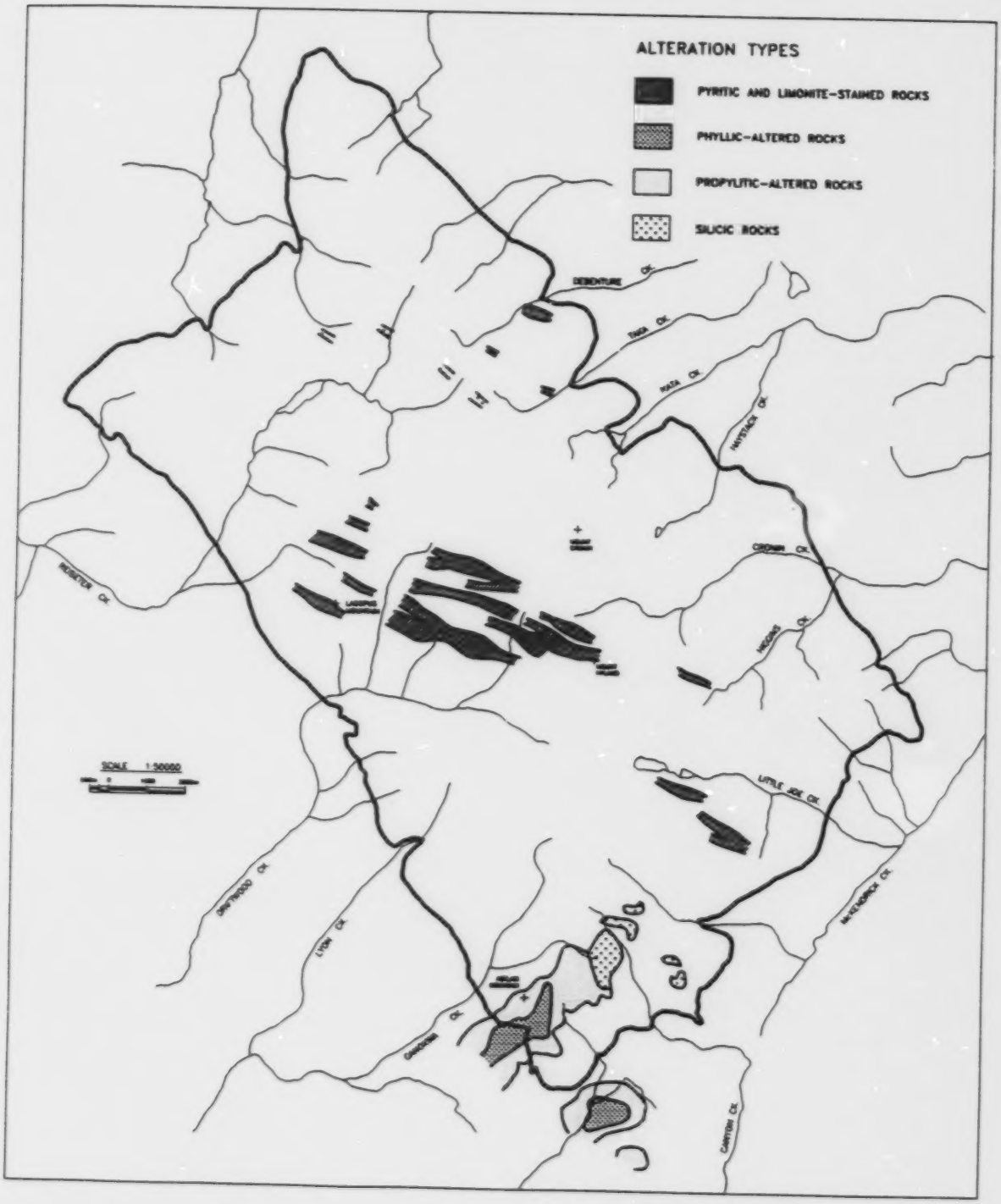



Figure 9. Distribution of altered rocks within the Babine Mountains Recreation Area [in part from Stock (1977b) and MacIntyre and Desjardins (1988b)].

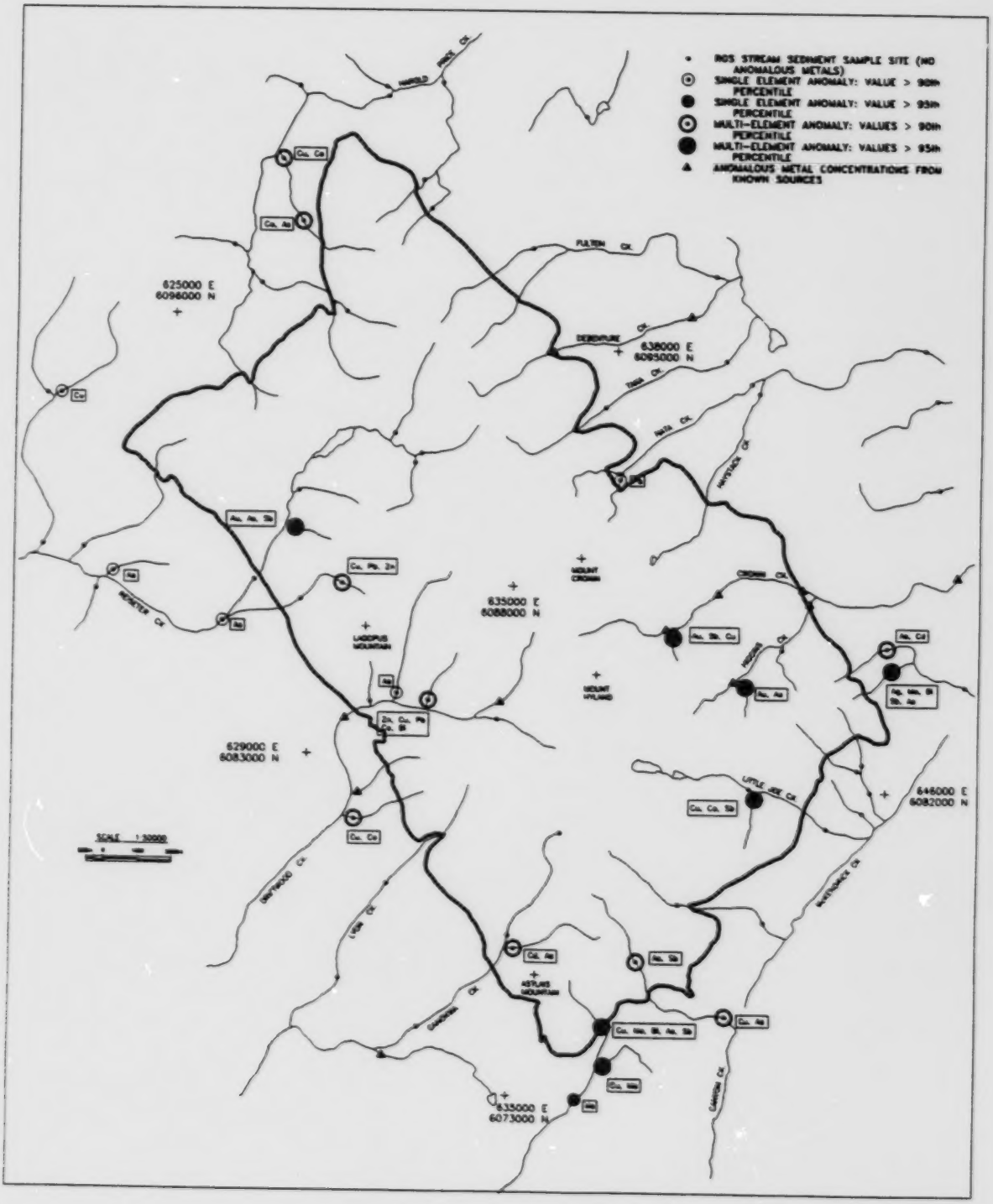



Figure 10. Stream-sediment sample sites in the Babine Mountains Recreation Area.

may contain more significant metal concentrations beneath the leached rocks exposed at surface.

In the north-central part of the study area, scattered exposures of Kasalka Group volcanic rocks are locally very silicic and may define a fault zone along which alteration has taken place (MacIntyre and Desjardins, 1988). However, no metals of interest are associated with these rocks.

Follow-up examination of a site initially sampled in 1987 (MacIntyre and Desjardins, 1988b) resulted in the location of previously undocumented polymetallic veins at the Rhyolite showing (Figure 6, Table 5; Gaba *et al.*, 1992). The veins are similar in character to other polymetallic veins in the area, but are unique because they contain up to 13 grams per tonne gold (partly as native metal - the only locality so far known within the study area!).

Geological mapping by Stock (1977b) on and adjacent to the Big Onion property documents the style and distribution of alteration associated with the deposit (Figures 7 and 9). Lithogeochemical sampling (also by Stock) shows that the distribution of copper and molybdenum is generally coincident with phyllic alteration associated with the Big Onion deposit; metals are also associated with phyllic-altered diorite to the southeast. However, an inherent problem with surface sampling of these types of deposits is the extensive metal leaching that occurs in rocks at or near the surface (as previously discussed), and resources beneath the surface might not be detected.

Samples were also collected regionally from rock outcrop not visibly altered: ten samples returned anomalous metal concentrations indicative of silver-rich polymetallic veins, four samples returned anomalous concentrations of metals characteristic of copper-silver veins and three samples returned anomalous concentrations suggestive of polymetallic massive sulphide mineralization (Appendix D).

Overall, lithogeochemical sampling is an effective tool in delineating areas of anomalous metal concentrations: several localities contain previously undocumented mineralization and represent the high degree of mineral resource potential that still exists in parts of the recreation area.

## STREAM-SEDIMENT GEOCHEMICAL SURVEY

Stream-sediment and water samples were collected from 39 sites throughout the Babine Mountains Recreation Area and analyzed according to standards set by the Regional Geochemical Survey program of the Ministry of Energy, Mines and Petroleum Resources (*e.g.*, Matysek *et al.*, 1990). This data complements previously collected data in the area to bring the sample site density to approximately 1 site per 6 square kilometres (Figure 10; Appendix E).

The composition of stream sediments is generally representative of the rocks they were derived from within a drainage basin. However, more than one rock type is typically drained by any particular stream. Prior to statistical analysis of data, each sample is designated as draining a single geological formation (the most dominant within the drainage basin). The data can then be statistically manipulated to provide the mean, median, mode, range, standard deviation and various percentile values for each element according to geological formation (Appendix E). This is necessary because the background concentrations of metals are different for different rock types (anomalous-*looking* values may not necessarily be, and vise versa). In this way, anomalous concentrations of metals (values $90^{th}$ percentile = anomalous; values $95^{th}$ percentile = very anomalous) are identified, and in most cases the character of the anomalous metal assemblage can be attributed to a particular mineral deposit type (Table 4) that the drainage basin potentially has within its boundaries.

Some samples from drainage basins where mining-related disturbances are present contain exceedingly large concentrations of metals. These analyses were noted and excluded from criteria used for mineral resource potential evaluation.

Twenty-two stream-sediment samples contain anomalous or very anomalous concentrations of metals: these include single and multi-element assemblages (Figure 10). The watersheds above the sample sites, therefore, are favourable areas to explore for mineral deposits (of the type indicated by the character of the metal assemblage) and represent areas of high mineral potential.

## GEOPHYSICAL SURVEYS

In some areas, geophysical surveys provide additional information about the physical properties of rocks, phenomena beneath the surface, or dominant structural trends which may be important in evaluating the geological favourability of an area for mineral deposits. Interpretation of geophysical anomalies requires knowledge of the geological character of the region. By using various geophysical techniques, geological formations that are favourable hosts to particular mineral deposit types can be traced beneath surface cover and exploration targets outlined (as done by induced polarization geophysical surveys southeast of the Big Onion, *see* Figure 7).

Regional airborne magnetic surveys (part of a province-wide program by the provincial and federal governments) have been carried out in the study area (Figure 11). The anomalies expressed by the magnetic contours are dependent on the variable magnetic intensities of the

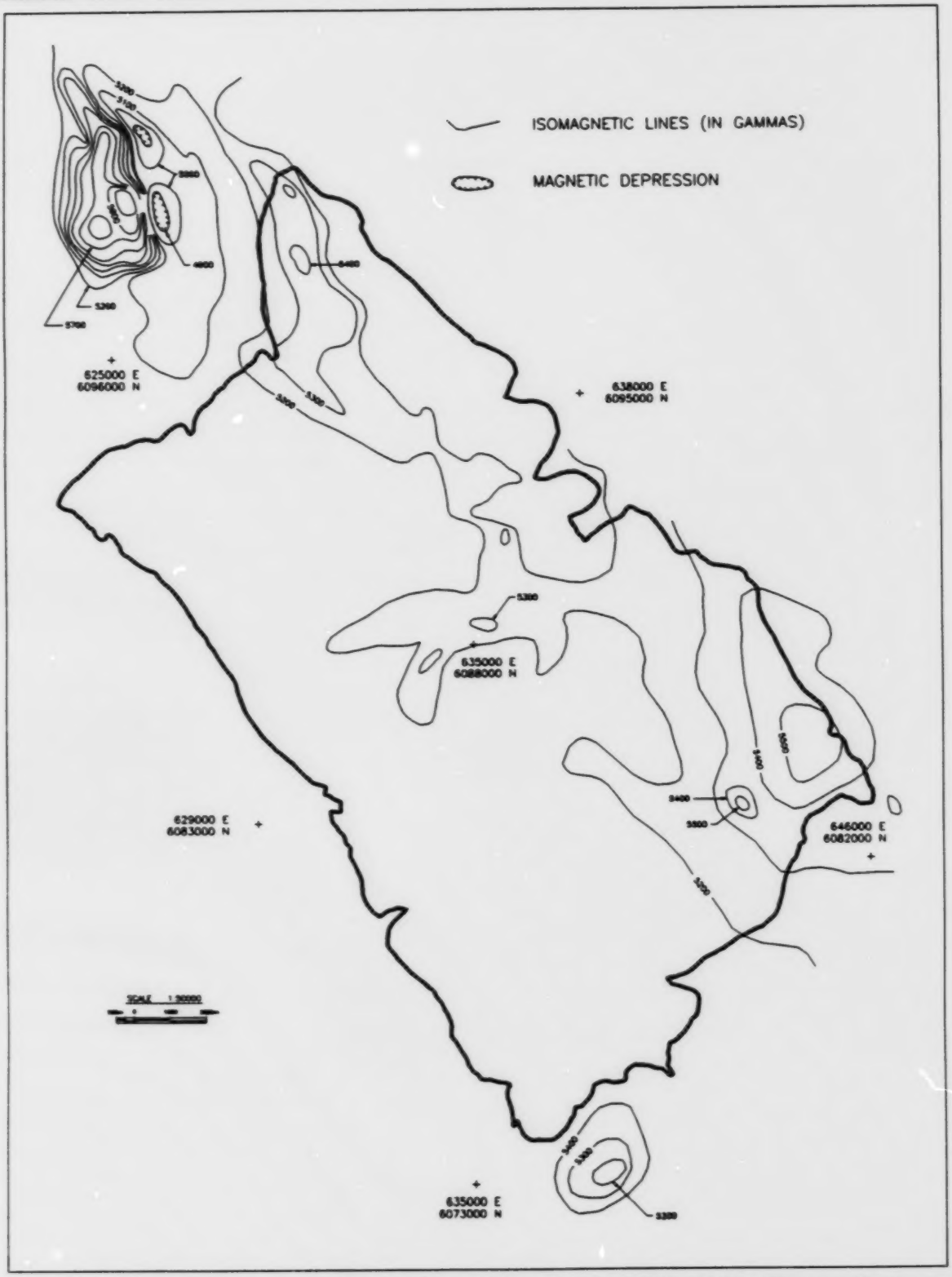
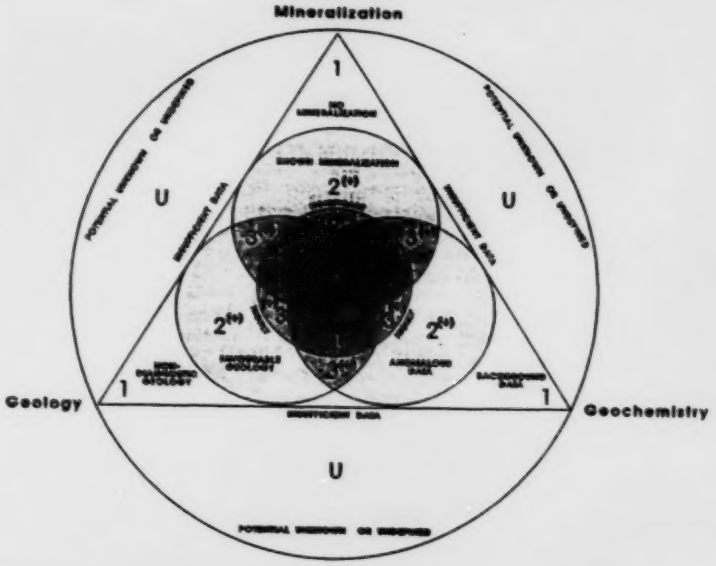



Figure 11. Airborne magnetic survey of the Babine Mountains Recreation Area (flight altitude is 300 metres above ground level). Compiled from *Geological Survey of Canada* Aeromagnetic Maps 5243G, 5244G, 5318G and 5319G.




DIAGRAMATIC CLASSIFICATION SCHEME OF METALLIC MINERAL POTENTIAL.
(Modified from McLaren, 1990).

QUALITATIVE DESCRIPTIONS OF MINERAL POTENTIAL RATINGS*

| Class | Mineral Potential | Description |
|---|---|---|
| 6 | Extreme | Known deposits (developed prospects) with identified resources in the ground. Very favourable geological data from all three criteria fields; very high degree of confidence in designation. Continued exploration highly probable; potential for mine development is high. |
| 5 | Very High | Known prospects, developed prospects or past producing mines (with undefined resources in the ground) in highly favourable metallogenic environment. Very favourable geological data from all three criteria fields; very high degree of confidence in designation. Future exploration highly probable. |
| 4 | High | Highly favourable metallogenic environment; mineral showings are generally present. Very favourable geological data from two criteria fields; high degree of confidence in designation. Future exploration expected. |
| 3 | Moderately High | Favourable metallogenic environment. Very favourable geological data from one criteria field, or favourable geological data from two criteria fields; high degree of confidence in designation. Future exploration likely; good potential for upgrading of classification. |
| 2 | Moderate | Moderately favourable metallogenic environment. Favourable geological data from one criteria field; moderate degree of confidence in designation. Future reconnaissance exploration to be expected; potential for upgrading of classification. |
| 1 | Low | Current geological data is nondiagnostic (no favourable geological data); moderate to high degree of confidence in designation. Future exploration not anticipated. |
| U | Unknown | Current data is either outdated or insufficiently detailed for a reasoned determination of mineral potential. High degree of confidence in designation. Future exploration could occur in parts of the area. |

*After McLaren (1990 and personal communication, 1992)

Figure 12. Classification of mineral resource potential.

## TABLE 6
## SUMMARY OF CRITERIA USED TO ASSESS PORPHYRY COPPER-MOLYBDENUM DEPOSIT POTENTIAL

| CRITERIA FIELD | OUTLINE/SYMBOL | DESCRIPTION | RATING | AREA OF INFLUENCE |
|---|---|---|---|---|
| FAVOURABLE GEOLOGY | | Late Cretaceous to Early Tertiary quartz diorite porphyry (qdp), quartz feldspar porphyry (qfp) and diorite (dr) | $2_G$, $2_G^*$ | outline of rock distribution |
| | | Propylitic, sericitic and silicic alteration zones | $2_{GA}$, $2_{GA}^*$ | outline of alteration zones |
| | | Coincidence of alteration zones with favourable host rocks | $3_G$, $3_G^*$ | outline of overlap |
| ANOMALOUS GEOCHEMISTRY | | RGS stream sediment samples with CuzMoAuzAg: | | |
| | ▲ | Single element anomaly defined by value > 95th percentile | $2_A^*$ | outline of drainage basin |
| | ▲ | Multi-element anomaly defined by values > 90th percentile | $3_A$ | outline of drainage basin |
| | ▲ | Multi-element anomaly defined by values > 95th percentile | $3_A^*$ | outline of drainage basin |
| | | Lithogeochemical samples with CuzMoAuzAg: | | |
| | ⊙ ▼ | Multi-element anomaly defined by very anomalous values* | $3_A^*$ | 200 metres radius |
| KNOWN MINERALIZATION | ● | Mineral showing | $2_M$ to 4 | 500 metres radius |
| | ■ | Developed prospect | 6 | 500 to 1000 metres radius |

*Multi-element anomalies delineated by lithogeochemical sampling in the area of the Big Onion prospect are from Stock (1977b). These anomalies are defined by a large number of anomalous samples rather than single anomalous samples, and therefore individual sample sites are not indicated.

## TABLE 7
## SUMMARY OF CRITERIA USED TO ASSESS SILVER-RICH POLYMETALLIC VEIN POTENTIAL

| CRITERIA FIELD | OUTLINE/SYMBOL | DESCRIPTION | RATING | AREA OF INFLUENCE |
|---|---|---|---|---|
| FAVOURABLE GEOLOGY | | Middle to Upper Jurassic Ashman Formation (muJA) / rhyolite | $2_G$, $2_G^*$ | outline of rock distribution |
| | | Upper Cretaceous Kasalka Group (uKK1, uKK2) and associated dikes | $2_G$, $2_G^*$ | outline of rock distribution |
| | | Pyritic-limonitic alteration zones | $2_{GA}$, $2_{GA}^*$ | outline of alteration zones |
| | | Coincidence of alteration zones with favourable host rocks | $3_G$, $3_G^*$ | outline of overlap |
| ANOMALOUS GEOCHEMISTRY | | RGS stream sediment samples with AgzAuzPbzZnzCdzCuzAszSb: | | |
| | ▲ | Single element anomaly defined by value > 90th percentile | $2_A$ | outline of drainage basin |
| | ▲ | Multi-element anomaly defined by values > 90th percentile | $3_A$ | outline of drainage basin |
| | ▲ | Multi-element anomaly defined by values > 95th percentile | $3_A^*$ | outline of drainage basin |
| | | Lithogeochemical samples with AgzAuzPbzZnzCdzCuzAszSb: | | |
| | ▼ | Single element anomaly defined by anomalous value | $2_A$ | 200 metres radius |
| | ⊙ ▼ | Multi-element anomaly defined by anomalous values | $3_A$ | 200 metres radius |
| | ▼ | Multi-element anomaly defined by very anomalous values | $3_A^*$ | 200 metres radius |
| KNOWN MINERALIZATION | ● ■ | Mineral showing: mineral prospect | $2_M$ to 5 | 500 metres radius |
| | | Past producer | 5 | 500 to 1000 metres radius |
| | | Past producer with identified resources in the ground | 6 | 500 to 1000 metres radius |

## TABLE 8
## SUMMARY OF CRITERIA USED TO ASSESS BASALT-HOSTED COPPER-SILVER VEIN POTENTIAL

| CRITERIA FIELD | OUTLINE/SYMBOL | DESCRIPTION | RATING | AREA OF INFLUENCE |
|---|---|---|---|---|
| FAVOURABLE GEOLOGY | | Lower to Middle Jurassic Telkwa Formation (lJT, lJTb) | $2_G$, $2_G^*$ | outline of rock distribution |
| ANOMALOUS GEOCHEMISTRY | | RGS stream sediment samples with CuzAgzAuzPbzZn: | | |
| | ▲ | Multi-element anomaly defined by values > 90th percentile | $3_A$ | outline of drainage basin |
| | | Lithogeochemical samples with CuzAgzAuzPbzZn: | | |
| | ▼ | Single element anomaly defined by anomalous value | $2_A$ | 200 metres radius |
| | ⊙ ▼ | Single element anomaly defined by very anomalous value | $2_A^*$ | 200 metres radius |
| | ▼ | Multi-element anomaly defined by anomalous values | $3_A$ | 200 metres radius |
| KNOWN MINERALIZATION | ● | Mineral showing | $2_M$ to 5 | 500 metres radius |
| | | Past producer | 5 | 500 to 1000 metres radius |

underlying rock, and may be due to conditions near the surface, or at unknown depths.

The anomaly immediately northwest of the recreation area is a steep magnetic high (Figure 11): this anomaly coincides with a ridge of augite porphyritic basalt (a rock type with a high magnetic susceptibility; Figure 4). The magnetic depression along the eastern margin of the magnetic high is attributed to a precipitous escarpment, or the abrupt absence of the augite porphyritic basalt.

There is another broad anomaly just south of the study area which coincides with a large diorite stock (Figure 4). A similar anomaly along the eastern boundary of the study area is not as readily explained by the nature of the exposed bedrock: it may indicate a similar igneous stock at depth.

Overall, the airborne magnetic survey does not offer any information with regard to areas which might be favourable for mineral resources.

## MINERAL RESOURCE POTENTIAL

### Mineral Potential Classification

Systematic integration of geological, geochemical and mineral occurrence data is the basis upon which mineral resource potential is determined (McLaren, 1990). Mineral potential is a rating of the likelihood that an area contains mineral deposits, based on the presence of favourable criteria which are indicative of the mineral deposit types of concern (*see* Table 4). Favourable criteria are defined as: the geological setting (as determined by mapping); anomalous concentrations of base or precious metals in bedrock or stream sediments (as identified by lithogeochemical or stream-sediment sampling); and known mineral occurrences (such as showings, prospects, developed prospects with identified resources and past-producers).

A numerical system of mineral potential classification was devised by McLaren (1990): favourable criteria of more than one type (applicable to a specific mineral deposit type) combine to define regions of higher mineral potential (Figure 12). Mineral potential maps were prepared for each deposit type and then combined into a composite mineral resource potential map for the study area.

### Mineral Resource Potential: By Deposit Type

Mineral resource potential has been determined for each of the mineral deposit types within and adjacent to the study area: porphyry copper-molybdenum deposits, silver-rich polymetallic veins, basalt-hosted copper-silver veins, and polymetallic massive sulphide deposits. Summaries of the criteria used to assess each of the deposit types are outlined in Tables 6 to 9, and are accompanied by maps (Figures 13 to 16) showing the ratings of potential for each mineral deposit type.

Areas of favourable geology (*i.e.*, favourable hostrocks) are designated as $2_G$ or $2_G{}^+$ : plus signs are used to indicate more favourable data. Areas of favourable rock alteration, a subclass of favourable geology, is designated as $2_{GA}$ or $2_{GA}{}^+$. Areas of favourable geology and alteration that overlap are designated as $3_G$ or $3_G{}^+$. The area of influence is the outline of the distribution of favourable hostrocks or alteration zones.

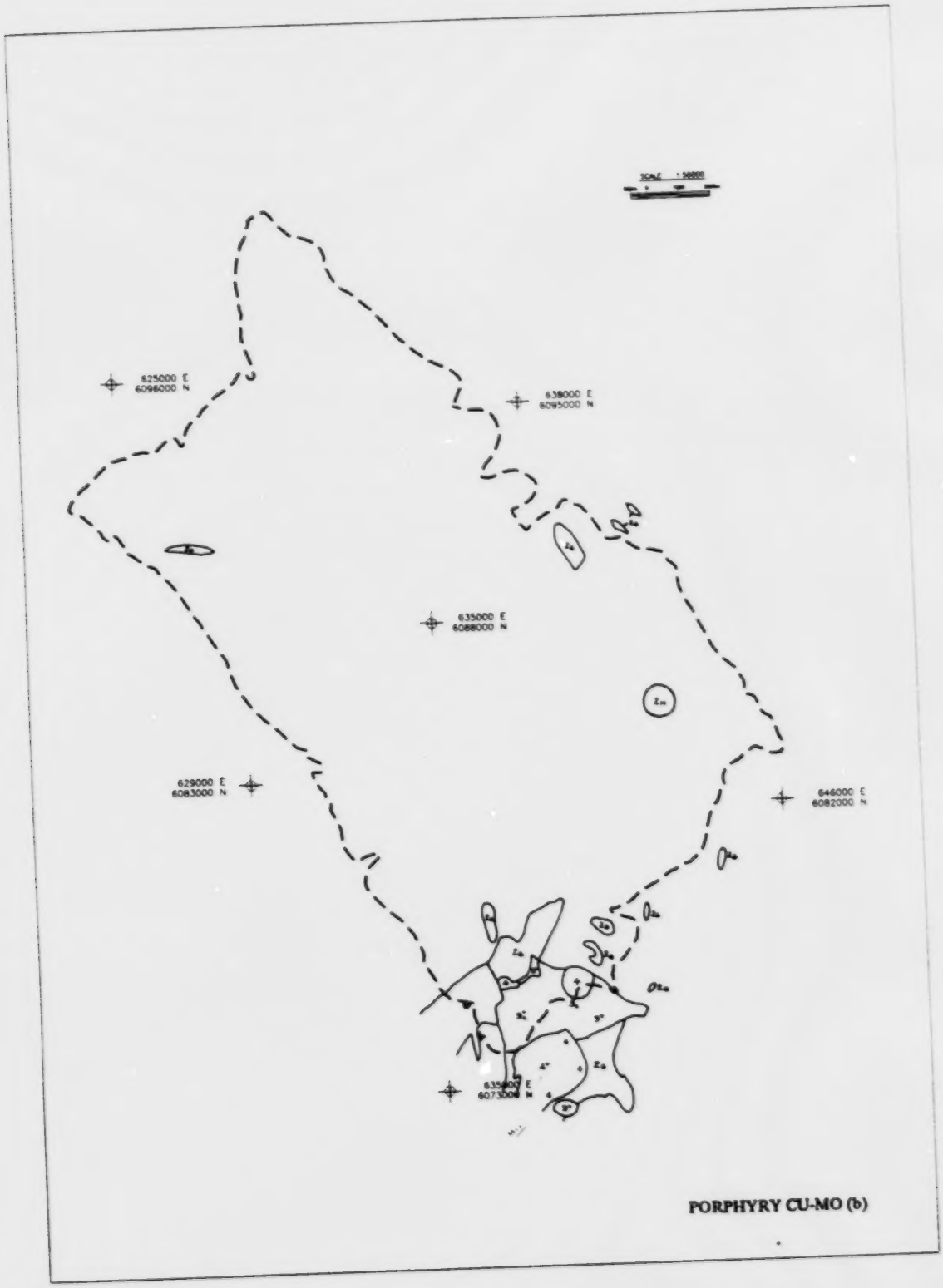
Areas of favourable geochemistry include sites from which stream-sediment samples and lithogeochemical (or rock) samples were taken that contain anomalous concentrations of characteristic base or precious metals. Anomalous stream sediment analyses which are greater than the 90th percentile for the specific data group (according to the metal assemblage and dominant rock formation within the drainage basin) are designated $2_A$ or $2_A{}^+$, depending on the number and identity of anomalous metals and their individual concentrations; those analyses greater than the 95th percentile are designated $3_A$ or $3_A{}^+$. The area of influence for anomalous stream sediment analyses is the drainage basin above the site where the sample was collected.

Anomalous lithogeochemical analyses (according to the characteristic metal assemblage) are designated $2_A$, $2_A{}^+$, $3_A$, or $3_A{}^+$, depending on how anomalous the

TABLE 9
SUMMARY OF CRITERIA USED TO ASSESS POLYMETALLIC MASSIVE SULPHIDE DEPOSIT POTENTIAL

| CRITERIA FIELD | OUTLINE/SYMBOL | DESCRIPTION | RATING | AREA OF INFLUENCE |
|---|---|---|---|---|
| FAVOURABLE GEOLOGY | | Lower Jurassic Nilkitkwa Formation (lJN) and upper parts of the underlying Telkwa Formation (lJT, lJTb) | $2_G$, $2_G{}^+$ | outline of rock distribution |
| ANOMALOUS GEOCHEMISTRY | | Lithogeochemical samples with Zn:Pb:Ba:Cu:As:<br>Single element anomaly defined by anomalous value | $2_A$ | 200 metres radius |
| KNOWN MINERALIZATION | | no known mineralization of this type within the study area | | |

Figure 13. Porphyry copper-molybdenum deposit potential: a) ratings as defined by individual criteria fields, and b) the final assigned ratings incorporating criteria field overlap (*see* Table 6 for explanation of symbols).


625000 E
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6088000 N
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6073000 N
PORPHYRY CU-MO (b)

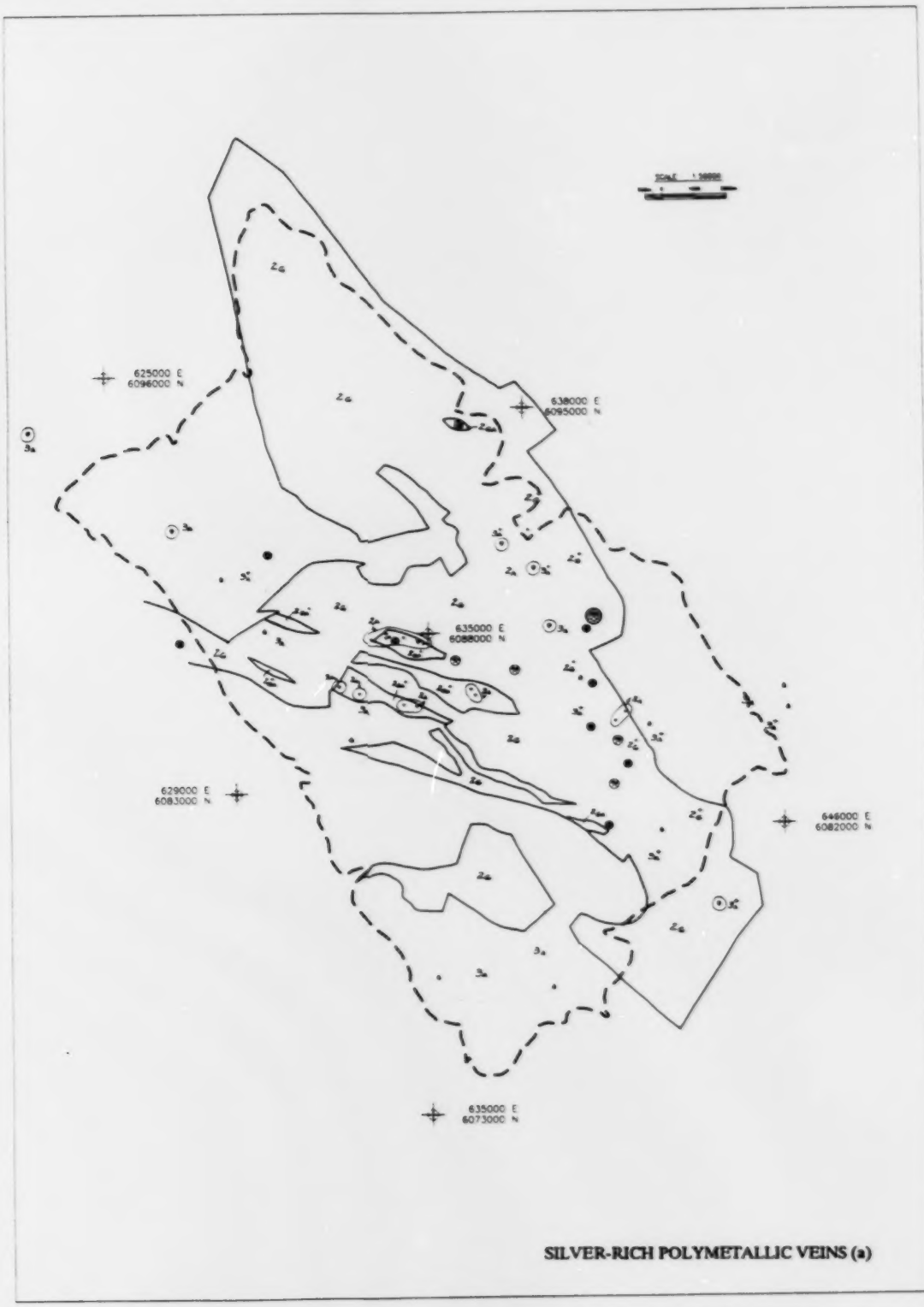
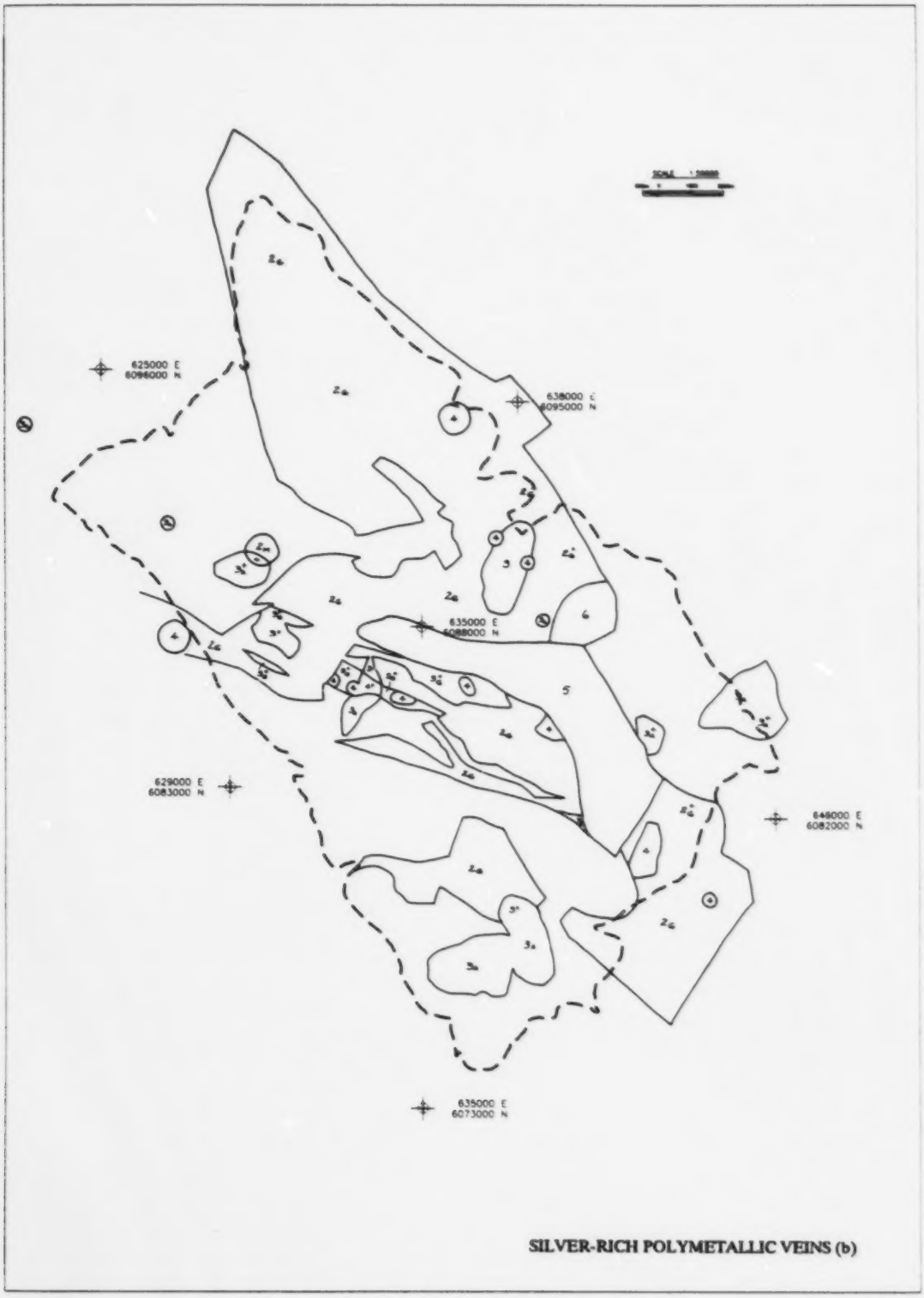



Figure 14. Silver-rich polymetallic vein potential: a) ratings as defined by individual criteria fields, and b) the final assigned ratings incorporating criteria field overlap (*see* Table 7 for explanation of symbols).




SILVER-RICH POLYMETALLIC VEINS (b)

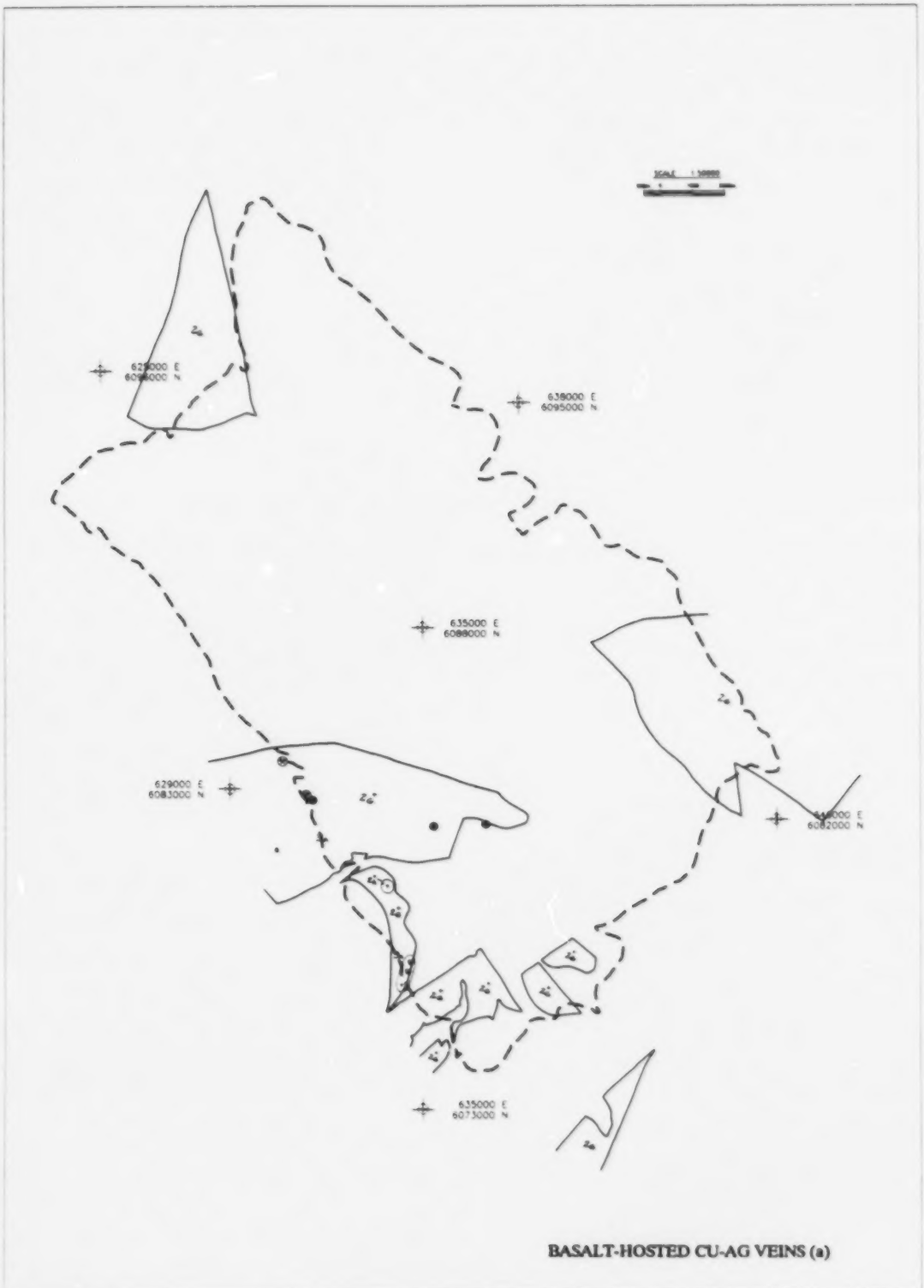
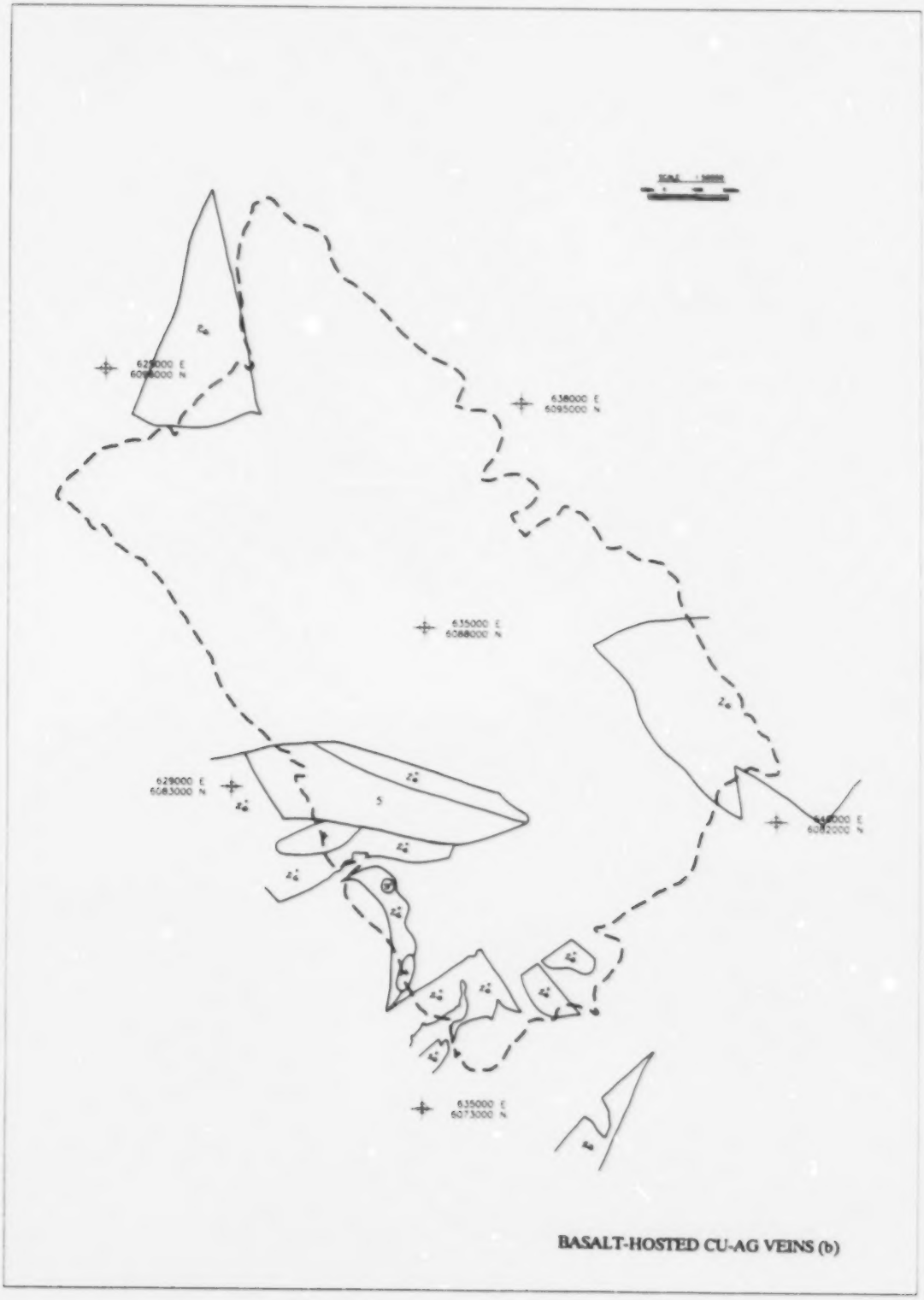



Figure 15. Basalt-hosted copper-silver vein potential: a) ratings as defined by individual criteria fields, and b) the final assigned ratings incorporating criteria field overlap (*see* Table 8 for explanation of symbols).




BASALT-HOSTED CU-AG VEINS (b)

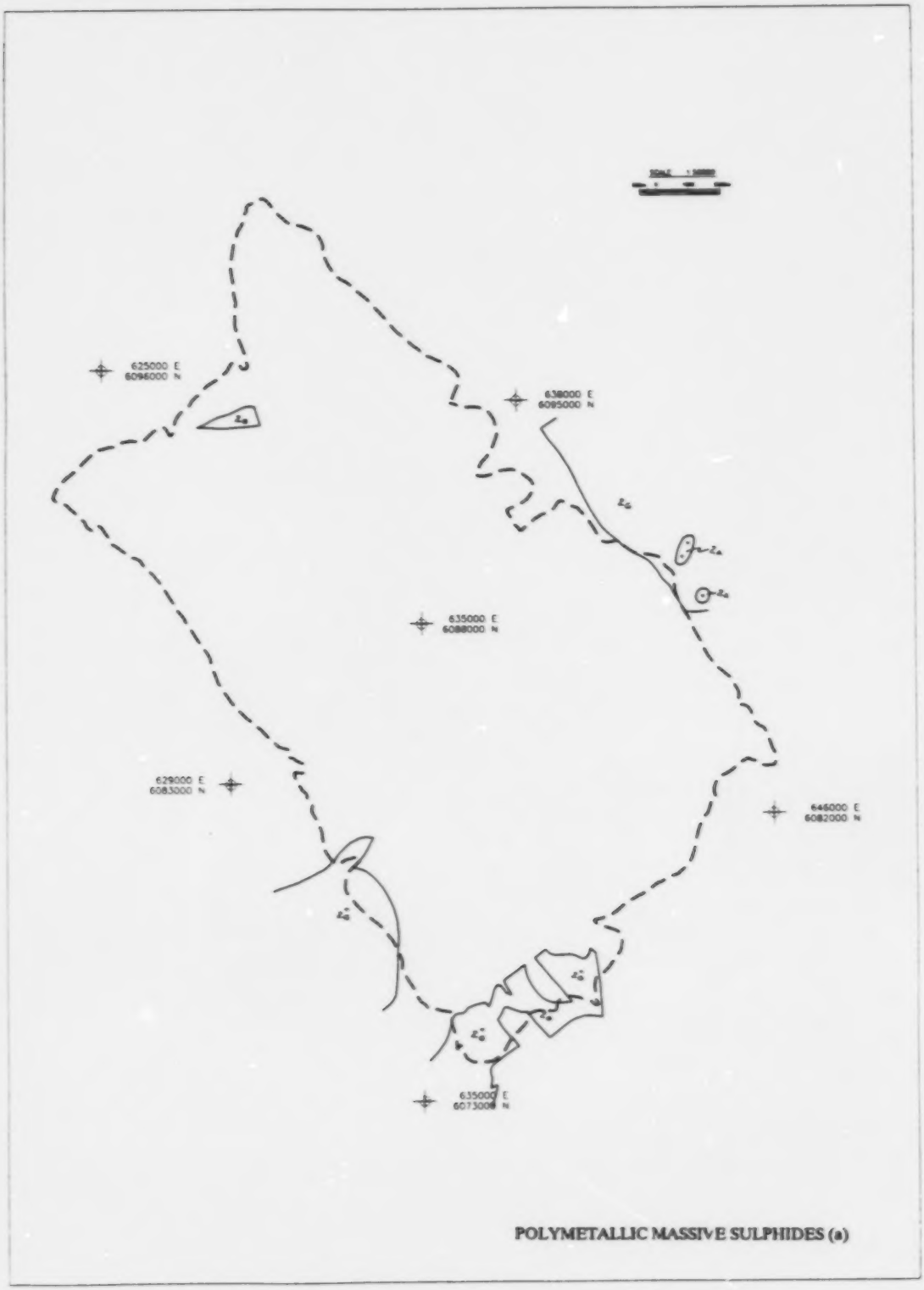
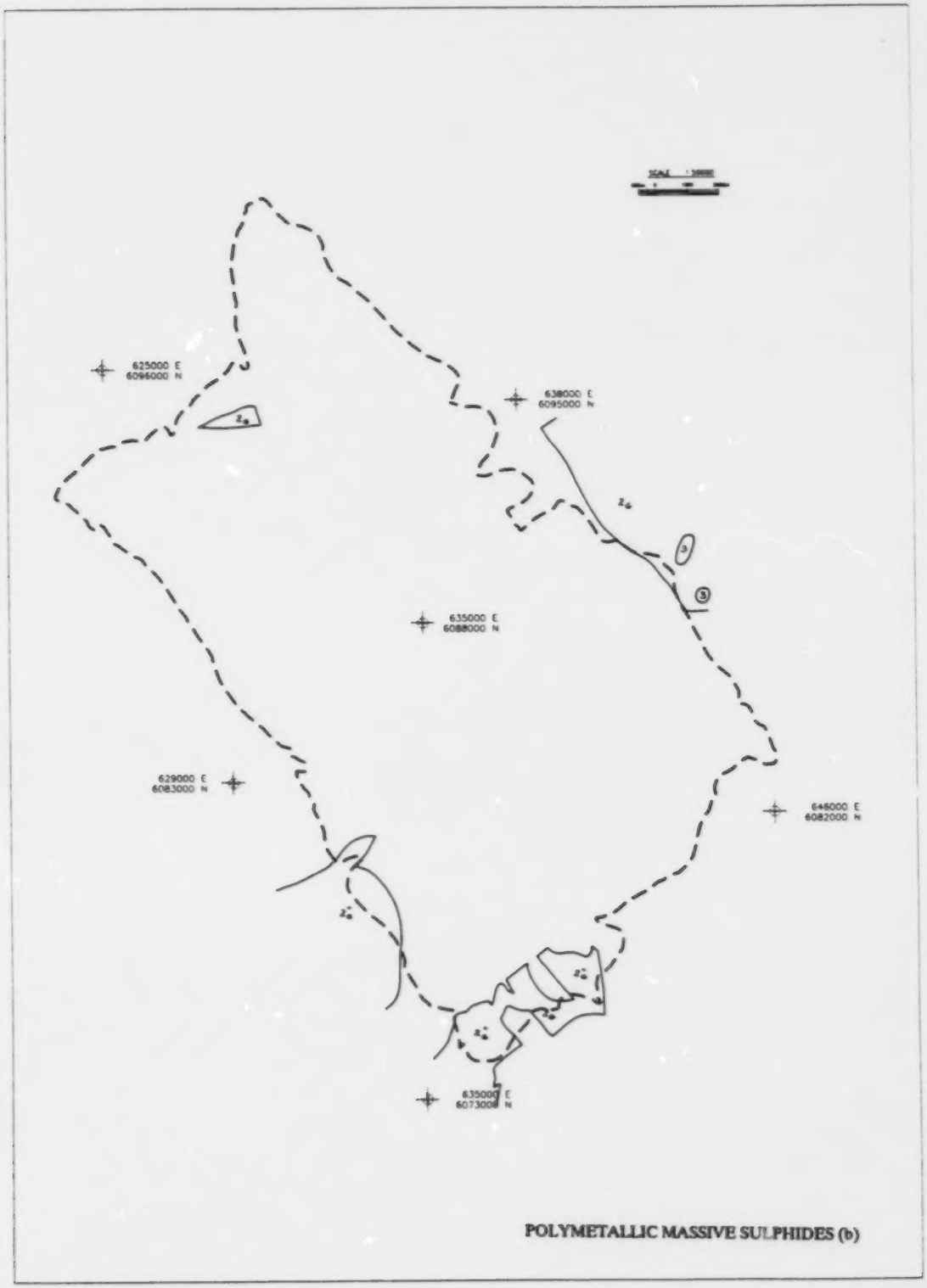



Figure 16. Polymetallic massive sulphide deposit potential: a) ratings as defined by individual criteria fields, and b) the final assigned ratings incorporating criteria field overlap (*see* Table 9 for explanation of symbols).




POLYMETALLIC MASSIVE SULPHIDES (b)

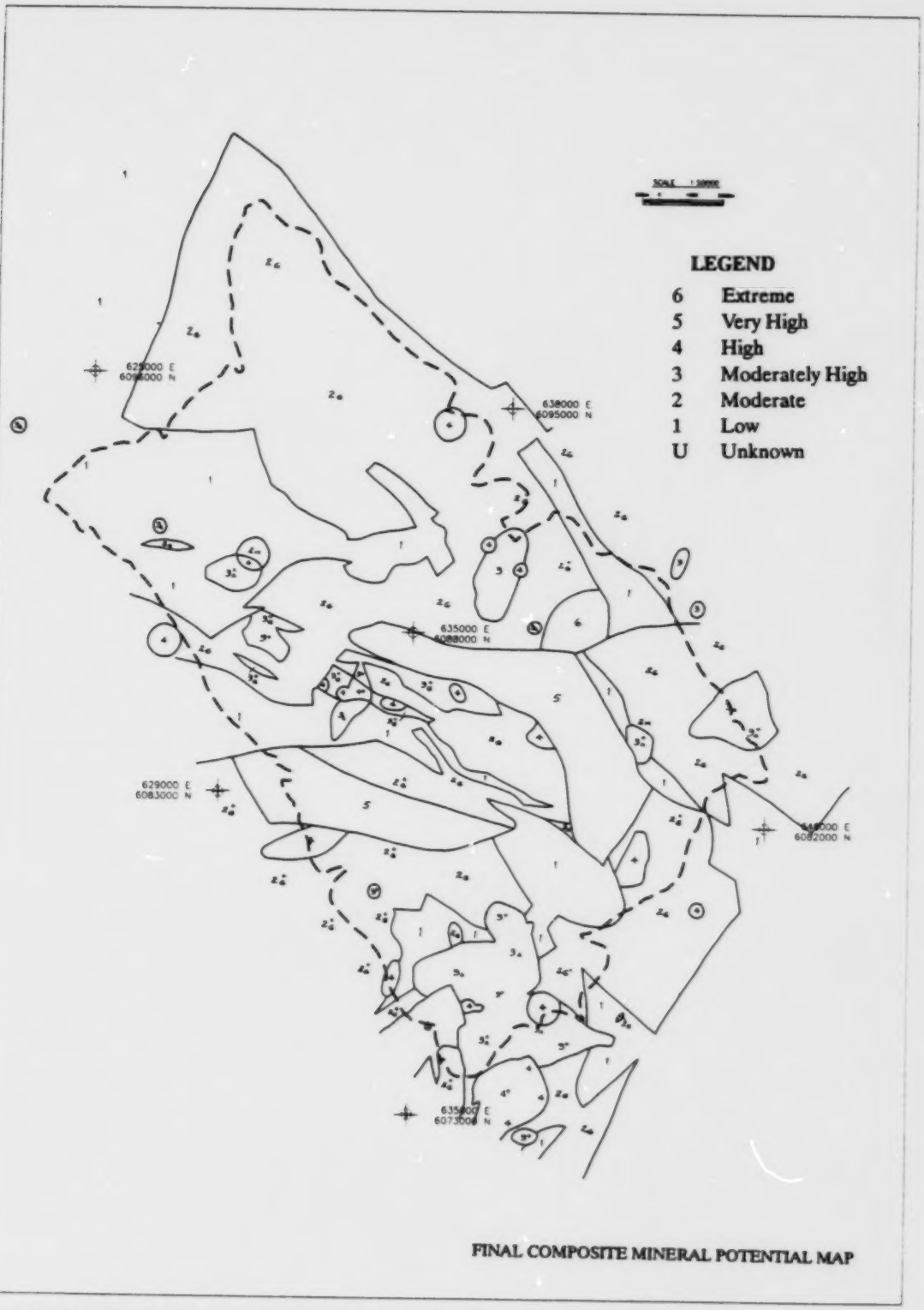



Figure 17. Composite mineral resource potential of the Babine Mountains Recreation Area (*see* Figure 12 for an outline of the classification of mineral resource potential).

analyses are (determined by visual inspection of the regional data set). An anomalous sample is assigned a radius of influence of 200 metres.

Known mineralization is categorized according to its status: mineral showings, prospects, developed prospects with identified resources and past-producers. Mineral showings and prospects are designated as $2_M$, $2_M^+$, $3_M$ or $3_M^+$, and are assigned a radius of influence of 500 metres. Past-producers are designated as high as 5, with an area of influence of 500 to 1000 metres radius. Developed prospects with identified resources have the greatest degree of significance and are designated as 6, with an area of influence of 500 to 1000 metres radius: this category includes past-producers that have identified mineral resources (such as the Cronin mine).

Areas of mineral potential, as defined by the distribution of favourable criteria, are shown for each mineral deposit type in Figures 13a to 16a. Areas where favourable criteria overlap indicate a greater degree of confidence, or an increased likelihood for a mineral deposit of a particular type to occur. A higher degree of mineral potential is therefore assigned to the region of overlap (Figure 12). This is shown for each of the mineral deposit types in Figures 13b to 16b. Areas in which favourable criteria overlap are designated 3, $3^+$, 4 or $4^+$, depending on the degree of confidence of the overlapping data (Figure 12). Mineral potential designations of 5 and 6 indicate areas where all three favourable criteria are present, and are generally assigned to areas with significant mineral occurrences, past-producers or developed prospects with identified resources: the latter is most significant because of its high potential for mine development. Areas in which no favourable criteria have been identified are designated as 1.

## Mineral Resource Potential of the Babine Mountains Recreation Area

Data presented in the mineral potential maps for each mineral deposit type (Figures 13b to 16b) are superimposed into one final composite mineral resource potential map for the study area (Figure 17).

An area of extreme mineral potential (Class 6) surrounds the identified copper and molybdenum resources at the Big Onion deposit in the south part of the recreation area (Figure 17). The region east and southeast of the Big Onion deposit also has indications of high mineral potential (Class 3 to 4) as defined by the presence of favourable geology (hostrocks and alteration), favourable geochemistry and a copper-molybdenum showing. Combined, these areas outline a domain of very high mineral resource potential for porphyry copper-molybdenum that covers the southern tip of the recreation area (Figures 13b and 17).

The Cronin mine and its identified resource of silver-rich polymetallic vein mineralization define an area of extreme mineral potential (Class 6) in the east-central part of the recreation area (Figure 17). This area is closely adjacent to a central belt of very high mineral potential (Class 5) for silver-rich polymetallic veins, based on the presence of very favourable geology (favourable hostrocks plus alteration), favourable geochemistry, and numerous vein showings (including three new veins found during this study) and past-producers. The regions immediately to the south and west also have smaller areas of high mineral potential (Class 3 and 4) defined by overlapping favourable geochemical data and geology. Together, these areas define a broad domain of high to very high mineral resource potential for silver-rich polymetallic veins within the central part of the recreation area (Figures 14b and 17).

The west-central belt of very high mineral potential (Class 5) is based mainly on favourable geology and contained copper-silver vein showings and past-producers (Figure 17). Favourable geology and geochemistry south of this belt outline small areas of high mineral potential (Class 3 and 4). These areas together form a domain of high to very high mineral resource potential for basalt-hosted copper-silver veins within the south-central and southwestern part of the recreation area (Figures 15b and 17).

# CONCLUDING REMARKS

## 90 YEARS OF EXPLORATION: ARE THERE STILL UNDISCOVERED MINERAL RESOURCES?

A mineral resource potential study such as this attempts to summarize the geological database as it is presently known. Examination and analysis of exposed bedrock does not always yield information on possible resources at depth: a thorough investigation of resource potential would ideally include geophysical surveys and diamond drilling to test for mineral resources below the surface.

Surface prospecting and sampling during the course of this study revealed three geologically significant previously undocumented polymetallic vein showings (Gaba *et al.*, 1992). During the present economic climate, showings such as these (and others in the study area) might not be pursued by the mining industry, but with changes in economic circumstances or exploration strategies in the future, may be considered as viable exploration targets. The significance of these new-found showings to this study is twofold: new mineral showings can still be found after 90 years of prospecting activity in the area, and new showings (along with previously known showings and favourable geology and geochemistry) help to delineate domains with high mineral potential that require further exploration.

Regionally extensive belts of pyritic and limonite-stained altered rocks, mainly within the central part of the study area, contain scattered anomalous concentrations of base or precious metals (as determined by lithogeochemical sampling). A plausible reason that metals are not more widespread within the altered rocks is that the pre-existing metals have been leached from the rocks by near-surface groundwater acidified by the natural oxidation of pyrite. Adequate evaluation would require more exploration and testing, possibly followed by drilling.

## THE BIG ONION DEPOSIT: PART OF BRITISH COLUMBIA'S MINERAL RESOURCE INVENTORY

An identified resource of copper and molybdenum (with accessory gold and silver) continues to be evaluated at the Big Onion property. Further exploration serves not only to better constrain the grade and distribution of the resource, but may lead to additional discoveries in favourable peripheral environments. The proximity of the Big Onion deposit to the town of Smithers is advantageous in keeping down the cost of exploration and development. At the same time, if development were to proceed, Smithers would undoubtedly gain economic benefits from the project. Under these circumstances the Big Onion deposit should not be alienated from future exploration and possible development.

### The Boundary Question and Multi-Use Land Management

The present boundary of the Babine Mountains Recreation Area generally follows the 1370 metre elevation contour. This boundary was chosen to exclude stands of merchantable timber (at lower elevations), thus avoiding possible land-use disputes with the forest industry (Babine Master Plan Study Team, 1991). In addition, exceptions to recreation area rules were made for snowmobile use in the Ganowkwa basin, a rapidly expanding recreation that attracts many people from out-of-town and boosts the local economy during the winter months. In contrast, the recreation area boundary cuts through the middle of the Big Onion copper-molybdenum-gold-silver deposit, the most promising mineral property presently being explored in the area.

The Smithers Exploration Group, an affiliation of prospectors, geologists, geophysicists and service groups and individuals associated with the mineral exploration industry in northwestern British Columbia, subsequently submitted their concerns to the Babine Mountains Recreation Area - Park Candidate Master Plan Study Team. Their recommendations included a proposed area boundary that excludes the Big Onion deposit and a sufficiently large area around the property to protect mining interests and future exploration access to an identified metal resource (Smithers Exploration Group, 1991). Further, to achieve balance, they proposed that the northern boundary be extended so as to include a comparable sized area of land with low mineral potential.

The region northwest of the recreation area at the headwaters of Harold Price Creek was examined during the field-based part of this study to investigate the feasibility of the Smithers Exploration Group submission. The area is underlain by rocks that are not likely hosts of metallic mineral deposits: this is exemplified by the lack of mineral showings and rock alteration in the area. The region is ideally suited as an addition to the recreation area in exchange for the exclusion of the Big Onion

deposit and environs. This area, to the northwest, has low mineral resource potential and therefore it is concluded that the Smithers Exploration Group's proposal should be given serious consideration.

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# APPENDICES

# APPENDIX A

ESTIMATED GROSS DOLLAR VALUES[1] OF THE BIG ONION AND CROWIN MINERAL DEPOSITS

| DEPOSIT TYPE | PROPERTY NAME | ESTIMATED TONNAGE | GOLD kg; $Million | SILVER kg; $Million | COPPER $10^6$ kg; $Million | LEAD $10^6$ kg; $Million | ZINC $10^6$ kg; $Million | MOLYBDENUM $10^6$ kg; $Million |
|---|---|---|---|---|---|---|---|---|
| Porphyry Cu-Mo | BIG ONION | 94 441 000 t[2] | 2033; $27.4[3] | 31760; $4.8[3] | 396.5; $1050 | | | 11.3; $67.4 |
| Silver-Rich Poly-metallic Veins | CROWIN | 47 210 t[4] | 80.2; $1.1 | 20205; $3.0 | 0.07; $0.2 | 3.8; $3.4 | 3.8; $5.2 | |

[1]Gross value of metal in the ground (before development, mining and extraction costs) according to average metal prices (in Canadian dollars) for the third quarter of 1991: gold $13.50 per gram, silver $0.15 per gram, copper $2.65 per kilogram, lead $0.90 per kilogram, zinc $1.37 per kilogram and molybdenum $5.95 per kilogram; the quantity of recoverable metals will be less than the estimated gross metal content of the deposit

[2]Calculation by Stock (1977a)

[3]Estimated precious metal content of the 31 760 000 t supergene zone

[4]From Melville et al., (1992)

# APPENDIX B


GEOLOGIC TIME SCALE - BRITISH COLUMBIA GEOLOGICAL SURVEY BRANCH
PHANEROZOIC
CENOZOIC
MESOZOIC
PALEOZOIC
PRECAMBRIAN
Phanerozoic data derived from:
1) W.B.Harland et al. (1990)
Precambrian data from:
1) Lumbers & Card (Geologic, Vol. 20 1991)
ERA
PERIOD
EPOCH / STAGE
Ma Age
EON
TERTIARY
NEOGENE
PALEOGENE
CRETACEOUS
JURASSIC
TRIASSIC
CARBONIFEROUS
PERMIAN
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
PROTEROZOIC
ARCHEAN
Neoproterozoic III
Cryogenian
Tonian
Stenian
Ectasian
Calymmian
Statherian
Orosirian
Rhyacian
Siderian
Neoarchaean (late)
Mesoarchaean (middle)
Paleoarchaean (early)
Eoarchaean (earliest)
base not defined
Calabrian
Piacenzian
Zanclian
Messinian
Tortonian
Serravallian
Langhian
Burdigalian
Aquitanian
Chattian
Rupelian
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Danian
Maastrichtian
Campanian
Santonian
Coniacian
Turonian
Cenomanian
Albian
Aptian
Barremian
Hauterivian
Valanginian
Berriasian
Tithonian
Kimmeridgian
Oxfordian
Callovian
Bathonian
Bajocian
Aalenian
Toarcian
Pliensbachian
Sinemurian
Hettangian
Norian
Carnian
Ladinian
Anisian
Spathian
Olenekian
Griesbachian
Induan
Changhsingian
Wuchiapingian
Capitanian
Wordian
Roadian
Kungurian
Artinskian
Sakmarian
Asselian
Gzhelian
Kasimovian
Moscovian
Bashkirian
Serpukhovian
Visean
Tournaisian
Famennian
Frasnian
Givetian
Eifelian
Emsian
Siegenian/Pragian
Gedinnian/Lochkovian
Pridolian
Ludlovian
Wenlockian
Llandoverian
Gamachian
Richmondian
Maysvillian
Edenian
Mohawkian
Chatfieldian
Whiterockian
Canadian
Tremadocian
Franconian
Dresbachian
Waucoban
Placentian
Hadrynian (late)
Helikian (middle)
Aphebian (early)
Neoarchaean (late)
Mesoarchaean (middle)
Paleoarchaean (early)
Eoarchaean (earliest)
208 ± 18 isotopic age for stage boundary & uncertainty;
(239) interpolated isotopic age for stage boundary

# APPENDIX C

## Chronological History of Exploration and Mining in the Babine Mountains Recreation Area (1866-1991)

**1866** The Collins Overland Telegraph line (Western Union Telegraph Company) was constructed along the Watsonquah River, shortly thereafter renamed the Bulkley River after Colonel Bulkley (Engineer-in-Chief of the operation).

**1878** H.J. Cambie, Canadian Pacific Railway, briefly reviewed the Bulkley Valley and its agricultural possibilities in connection with explorations of proposed railway routes.

**1879** G.M. Dawson, Geological Survey of Canada, made an exploratory trip across the Babine Range up the Suskwa River and over the height of land to Babine Lake.

**1898** The Collins Overland Telegraph trail along the Bulkley Valley was used as a route to the Klondike gold fields by a rush of prospectors; copper-gold veins and coal seams were reported from the region.

**1903** Assessment work was done on the *Eldorado* claim (Harvey Mountain area)

**1905** W.F. Robertson, Provincial Mineralogist, explored the region and visited mineral claims on Harvey Mountain; the *Dibble (or Babine-Bonanza)* veins were discovered by prospectors from Hazelton; claims were staked in Ganokwa basin.

**1906** W.W. Leach, Geological Survey of Canada, began scientific geological examinations (1906-1910).

**1908** Prospecting and exploratory work was done on at least 25 mineral properties within the Babine Range, with the hopes that the construction of a line of the Grand Trunk Pacific Railway would be built throughout the length of the Bulkley Valley.

**1909** The railway now assured, miners flocked in and considerable work was done on more than 20 mineral prospects; surface and underground work (drifting) was done on the *Pack Train (or Drift)* property (by P. Harvey); the *Dibble (or Babine-Bonanza)* group was acquired by the Babine-Bonanza Mining Company (J. Cronin and Associates) and work began.

**1910** Construction on the railway began (1910-1914); extensive underground work began on the *Babine-Bonanza* - considerable interest in this silver property drew attention to the region.

**1911** Considerable work was done on existing mineral properties, particularly the *Babine-Bonanza* - trails from Telkwa, Morricetown, and Hudson's Bay Company ranch (on Driftwood Creek) to the *Babine-Bonanza* area were in use; about 42 new claims were recorded.

**1912** Fourty-eight new claims were recorded.

**1913** The town of Smithers was founded; silver-lead veins on the *Debenture* group were explored by drifting (by Ritzins and Morton); 71 new claims were recorded.

**1914** Underground development continued on the *Debenture* (by Ritzins and Morton) and the *Babine-Bonanza* properties; 46 new claims were recorded.

**1916** Seventy-two new claims were recorded.

**1917** A sleigh road linking the *Babine-Bonanza* to the railway at Telkwa was completed (with a grant from the Mines Development Fund) and 72 tonnes of hand-cobbed silver-lead ore were brought out: to date 762 metres of shafts and tunnels had been put in - all work was by hand as no machinery was on the site; 6 tonnes of silver-lead ore was produced from the *Victoria (or Lorraine)* group; 6 tonnes of high-grade silver ore was shipped from the *Silver King* property.

**1918** The *Cimbria (or Big Onion)* group was staked (by A. Elmsted and associates); underground development continued at the *Victoria* group (by P.J. Higgins); 23 tonnes of hand-cobbed silver-copper ore was brought out (1915-1918) from the *Harvey (or Drift)* group (by C.G. Harvey and W.J. Larkworthy); surface and underground exploration (drifting) was done at the *Social (or Jud)* group (by A.P. McCabe and P. McPhee).

**1919** Construction of the McCabe trail to the *Social* group and the Harvey Mountain trail to the *Harvey* group was completed (both built with grants from the Mines Development Fund); underground development continued at the *Harvey* (by C.G. Harvey and W.J. Larkworthy) and *Silver King* groups, and work continued at the *Babine-Bonanza* property.

**1920** Extensions were added to the McCabe trail (with grants from the Mines Development Fund) and included the Silver King basin trail to the *Silver King* group, and a trail to the *Victoria (or Lorraine)* group (now part of the Little Joe trail); underground development continued at the *Babine-Bonanza* property (by Babine-Bonanza Mining and Milling Company).

**1921** Underground development continued at the *Babine-Bonanza*, *Driftwood* (by J.T. Driscoll), *Harvey* and *Silver King* (by P.J. Higgins) groups.

**1922** Underground development commenced at the *Hyland Basin* (by M. Cain and T. King) and *Little Joe (or Silver Pick)* (by M. Cain and T. King) groups; underground development continued at the *Silver King* (by W. Foley and E. Lee), *Victoria* (by P.J. Higgins) and *Social* groups.

**1923** Underground development continued at the *Babine-Bonanza*, *Hyland Basin* (by J.F. Duthie) and *Little Joe* (by M. Cain and T. King) groups.

**1924** G. Hanson, Geological Survey of Canada, carried out the first systematic geological mapping of the southern Babine Range, including mineral prospect examination; underground work continued at the *Silver King* (by P.J. Higgins), *Victoria* (by P.J. Higgins), *Rainbow (or Driftwood)*, *Hyland Basin* (by J.F. Duthie) and *Little Joe* (by M. Cane and T. King) groups; underground work (drifting) was carried out at the *Cimbria* (or *Big Onion*) property (by A. Elmsted and associates).

**1925** Underground development continued at the *Silver King* (by P.J. Higgins and associates), *Hyland Basin* (by Gale and Milligan), *Harvey* (by C.G. Harvey) and *Little Joe* (by M. Cain and T. King) groups; J. Cronin, manager of the *Babine-Bonanza* property died of injuries received in 1923 when his horse fell on him.

**1926** Construction of the Little Joe Creek trail (built with a grant from the Mines Development Fund) now linked the *Little Joe* group with the *Babine-Bonanza* sleigh road; underground development continued at the *Silver King*, *Hyland Basin*, *Victoria*, *Silver Saddle*, *Little Joe* and *Harvey* (by C.G. Harvey) groups.

**1927** Six tonnes of hand-sorted silver ore were shipped from the *Silver King* property; 9 tonnes of silver ore was taken out of the *Little Joe* property; 4.5 tonnes of silver-copper ore was shipped from the *Harvey* property; underground development (drifting) continued at the *Cimbria (or Big Onion)* group (by A. Elmsted).

**1928** The *Babine-Bonanza* group was acquired by Babine-Bonanaza Metals Limited and underground operations continued; continued underground development (drifting) at the *Victoria* group (by Lorraine Copper-Silver Mines Limited).

**1929** A new trail from the Little Joe Creek trail to the *Victoria* group was built; underground work continued at the *Victoria* (by Lorraine Copper-Silver Mines Limited), *Rainbow*, *Harvey* (by Consolidated Mining and Smelting Company of Canada Limited), and *Little Joe* properties; underground development continued at the *Babine-Bonanza* property and 27 tonnes of hand-sorted silver-lead ore were shipped (by Babine-Bonanza Metals Limited); trenching was done on the *Silver Saddle* property (by A.T. Harrer and B.F. Messner).

**1930** Underground development continued at the *Rainbow*, *Silver King* (by Omineca Silver King Mining Company Limited), *Victoria* (by Lorraine Copper-Silver Mines Limited) and *Babine-Bonanza* groups.

**1931** Underground work continued at the *Babine-Bonanza*, *Silver King* (by Omineca Silver King Mining Company Limited), *Victoria* (by Lorraine Copper-Silver Mines Limited) and *Little Joe* (by T. King) groups.

**1932** Work continued at the *Rainbow* and *Cimbria* (by A. Elmsted and B. Mueller) groups.

**1935** Six tonnes of hand-sorted silver ore were packed out of the *Hyland Basin* property.

**1936** Nine tonnes of hand-sorted silver ore were packed out of the *Silver Pick (or Little Joe)* property (by J.J. Herman).

**1937** Nine tonnes of hand-sorted silver ore were packed out of the *Skookum (or Silver King)* group (by J. Baker); 9 tonnes of hand-sorted silver-copper-gold ore were packed out from the *Rainbow* group (by F.H. Johnson).

**1938** Five tonnes of hand-sorted silver ore were shipped from the *Little Joe* property (by A. Elmsted).

**1939** Camp construction commenced at the *Silver King* property (by La Marr Gold Mines Limited).

**1940** Surface and underground work was done at the *Silver King* group (by La Marr Gold Mines Limited); 4 tonnes of hand-sorted silver ore were shipped from the *Hyland Basin* group (by H.W. Agnew and Associates).

**1948** Underground and surface diamond drilling was done at the *Babine-Bonanza* (by Cronin Babine Mines Limited), and a 112-kilogram sample sent for metallurgical tests.

**1950** Construction began on a new road between the *Babine-Bonanza* group and the recently completed Chapman Lake road (now known as the Babine Lake road), with plans for installing a mill on the property.

**1951** The new road was completed, many of the new mine buildings were constructed and 55 tonnes of previously stockpiled ore was shipped from the *Babine-Bonanza* property; surface work continued at the *Lorraine* (by Yellowknife Gold Mines Limited) and *Hyland Basin* (by Yellowknife Gold Mines Limited) properties.

**1952** Parts of the *Cronin (or Babine-Bonanza)* property were rehabilitated, a road from the mine to the mill site was built and several buildings completed, including a 36 tonne-per-day mill (by Cronin Babine Mines Limited); 3185 tonnes of ore were milled (concentrates containing silver, gold, lead, zinc, copper and cadmium were shipped to the Trail smelter), but operations ceased by the year end due to low base metal prices.

**1956** Work resumed at the *Cronin mine* (by New Cronin Babine Mines Limited), including underground development, and 3811 tonnes of ore were milled.

**1957** Underground work at the *Cronin mine* continued, and 5370 tonnes of ore were milled.

**1958** A road was built up Higgins Creek joining the *Lorraine* property to the *Cronin mine* road; some underground work was done at the *Lorraine*; the *Cronin mine* was leased from New Cronin Babine Mines Limited by P. Kindrat, who with his family operated the mine each summer until 1972 when it was sold to Hallmark Resources Limited: 112 tonnes of unmilled ore and 8 tonnes of lead concentrate were shipped from the *Cronin mine*.

1959 Seventy-four tonnes of lead concentrate and 60 tonnes of zinc concentrate were shipped from the *Cronin mine* (operated by the Kindrat family).

1960 Seventy-two tonnes of lead concentrate and 60 tonnes of zinc concentrate were shipped from the *Cronin mine*.

1961 Seventy-three tonnes of lead concentrate and 84 tonnes of zinc concentrate were shipped from the *Cronin mine*.

1962 Three hundred and sixty-three tonnes of ore was mined at the *Cronin mine*, but no concentrates shipped.

1963 Underground development and exploration (diamond drilling) continued at the *Cronin mine*, and 25 tonnes of lead concentrate and 33 tonnes of zinc concentrate were shipped.

1964 Underground development and exploration (diamond drilling) continued at the *Cronin mine*, and 41 tonnes of lead concentrate and 72 tonnes of zinc concentrate were shipped; underground development and camp construction commenced at the *Debenture* group (by Native Mines Limited); trenching, geophysics, and diamond drilling at the *Astlais (or Big Onion)* property began (by Noranda Exploration Company Limited).

1965 Underground development continued at the *Cronin mine*, and 99 tonnes of lead concentrate and 138 tonnes of zinc concentrate were shipped.

1966 Eighty-three tonnes of lead concentrate and 124 tonnes of zinc concentrate were shipped from the *Cronin mine* (by the newly formed Kindrat Mines Limited); underground development and exploration (diamond drilling) continued at the *Lorraine* property (by Native Mines Limited); bulldozer stripping and road building, geophysics and diamond drilling were carried out at the *Big Onion* property (by Texas Gulf Sulphur Company); geochemical sampling and trenching were done at the *Rainbow (or Driftwood)* property (by Reindeer Mines Limited).

1967 Fifty-one tonnes of lead concentrate and 76 tonnes of zinc concentrate recovered from ore mined from surface pit and underground were shipped from the *Cronin mine* ; exploration (diamond drilling) continued at the *Big Onion* property (by Texas Gulf Sulphur Company); road construction and trenching was done on the *Mert* group (northeast of the *Big Onion* property) (by Tro-Buttle Exploration Limited); geochemical sampling was done on the *Debenture* property (by Wanda Mines and Exploration Limited).

1968 Surface exploration continued at the *Mert* group (by Tro-Buttle Exploration Limited) and the *Rainbow* group (by D.W. Small and Associates).

1969 Twenty-two tonnes of lead concentrate and 25 tonnes of zinc concentrate recovered from ore from surface pits and old dumps were shipped from the *Cronin mine*; 13.5 tonnes of high-grade copper-silver ore was shipped from the *Rainbow* property (by J. Millhouse).

1970 H. Tipper, Geological Survey of Canada, began reconnaissance geological mapping in the Smithers map area (1969-1970); seventy-nine tonnes of lead concentrate and 94 tonnes of zinc concentrate were shipped from the *Cronin mine* (some surface exploration was also done); surface exploration (geophysics and geochemistry) continued at the *Big Onion* property (by Blue Rock Mining Corporation Limited); surface exploration (geophysics) continued at the *Mert* group (by Tro-Buttle Exploration Limited); trenching and diamond drilling was done on the *Jud (or Social)* group (by Rockwell Resources Limited).

1971 Eighty-three tonnes of lead concentrate and 113 tonnes of zinc concentrate recovered from ore from surface pits and underground were shipped from the *Cronin mine*; underground mapping at the *Drift (or Harvey)* group was completed and 4.5 tonnes of high-grade silver-copper ore were shipped out (by Driftwood Mines Limited).

1972 Underground development continued at the *Cronin mine*, and 69 tonnes of lead concentrate and 74 tonnes of zinc concentrate were shipped; bulldozer trenching was done on the *Drift* property (by Driftwood Mines Limited).

**1973** Construction at the *Cronin mine* included: a tailings disposal area, upgraded camp facilities and restored mill; surface exploration (exposing the new *Upper showing* ) and underground development continued at the *Cronin mine*, and 78 tonnes of lead concentrate and 73 tonnes of zinc concentrate were shipped (by Hallmark Resources Limited).

**1974** Underground development continued at the *Cronin mine*, and 36 tonnes of lead concentrate and 64 tonnes of zinc concentrate were shipped; exploration (geophysics and diamond drilling) continued at the *Big Onion* property (by Canadian Superior Exploration Limited).

**1975** Surface diamond drilling (to test the open-pit potential of the *Upper showing*) and surface and underground surveying were done at the *Cronin mine* (by Coca Metals Limited); surface diamond and percussion drilling and geochemical surveys were done at the *Big Onion* property (by Canadian Superior Exploration Limited).

**1976** Surface diamond and percussion drilling, geochemical surveys and geological mapping continued at the *Big Onion* property (by Canadian Superior Exploration Limited); trenching was carried out on the *Driftwood (or Rainbow)* group (by P.J. Huber and L.B. Warren).

**1977** Geochemical surveys, geological mapping and geophysics continued at the *Big Onion* property (by Canadian Superior Exploration Limited); a geochemical survey was carried out on the *Driftwood (or Rainbow)* group (by Petra Gem Explorations Limited); trenching was done on the *Native* group (by J.M. Hutter); geological mapping and underground sampling was done at the *Cronin mine* (by Hallmark Resources Limited).

**1981** Surface diamond drilling was done at the *Silver King* property (by Silver Hill mines); underground sampling was carried out at the *Cronin mine* (by Hallmark Resources Limited).

**1983** Underground sampling and surface diamond drilling was done at the *Cronin mine* (by Goldsil Mining and Milling Incorporated).

**1984** The Babine Mountains Recreation Area was established by Order-In-Council #676, under management of the Ministry of Parks; trenching was carried out at the *AG (or Silver Bax)* property (by Van Silver Holdings Limited).

**1985** Underground exploration (drifting) was done at the *Silver King* property (by Silver Hill Mines).

**1986** D. MacIntyre, P. Desjardins and others, British Columbia Geological Survey Branch, initiated geological mapping and mineral deposit studies in the southern Babine Range.

**1987** Geological mapping, geochemical sampling and geophysical surveys were done on the *Cronin mine* property (by Southern Gold Resources Limited); geochemical sampling was carried out at the *Big Onion* property (by Noranda Exploration Company Limited).

**1988** The Mineral Tenure Act became effective and made provisions for exploration within recreation areas: work done outside a claim (access, etc.) is subject to both a Ministry of Parks Resource Use Permit and a Mines Act approval. Any work within a claim must be authorized under a Resource Use Permit and Mines Reclamation Permit containing conditions agreeable to both ministries. Later in the year Order-In-Council #151 was passed, protecting all mineral claims located within a recreation area from forfeiture for a period of one year after the date a Resource Use Permit is issued under the Park Act; geophysical surveys were done on the *Cronin mine* property (by Southern Gold Resources Limited).

**1991** Order-In-Council #151 was rescinded by Order-In-Council #185 which gave title holders until 31 October, 1992 to comply with Section 25 of the Mineral Tenure Act: this was necessary because of problems in the issuance of Resource Use Permits; surface diamond drilling was done on the *Big Onion* property (by Mindoro Corporation and Varitech Resources Limited).

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Sources of information: British Columbia Ministry of Mines Annual Reports (1898-1968); Geology, Exploration and Mining in British Columbia (1969-1988); Morice (1904); L'Orsa (1990); unpublished Assessment Reports and other company reports.

# APPENDIX D

## Lithogeochemical Analyses

Rock-chip samples collected from the study area in 1986, 1987 and 1988 (sample numbers 1 to 119) were analyzed by the Ministry of Energy, Mines and Petroleum Resources, Geological Survey Branch Analytical Sciences Laboratory. Samples were jaw crushed, split and then ring pulverized in a tungsten-carbide mill. Silver, copper, lead, zinc, molybdenum, arsenic and antimony were determined by atomic absorption spectrophotometry. Gold was determined by fire assay with atomic absorption finish, in part by Acme Analytical Laboratories, Vancouver, B.C.

Rock-chip samples collected in 1991 (samples 120 to 243) were processed as above and analyzed by the Analytical Sciences Laboratory for Ag, Cu, Pb, Zn and Cd by atomic absorption spectrophotometry. In addition, Au, Mo, As and Sb were determined by neutron activation by Actlabs, Ancaster, Ontario; samples with high gold concentrations were re-analysed by fire assay with atomic absorption finish by Chemex Laboratories Limited, North Vancouver, B.C.

All elements are expressed in parts per million, except gold which is in parts per billion. Detection limits are as follows:

| Element | Method | Detection Limit (ppm) |
|---|---|---|
| Au (1986) | fa/aas | 17 (ppb) |
| Au (1987) | fa/aas | 20 (ppb) |
| Au (1988) | fa/aas | 1 (ppb) |
| Au (1991) | na | 5 (ppb) |
| Au (1991) | fa/aas | 1 (ppb) |
| Ag (1986) | aas | 0.6 |
| Ag (1987) | aas | 0.5 |
| Ag (1991) | aas | 0.5 (samples 120-158) |
| Ag (1991) | aas | 0.4 (samples 159-243) |
| Cu | aas | 2 |
| Pb (1986-88) | aas | 5 |
| Pb (1991) | aas | 4 |
| Zn | aas | 2 |
| Mo (1986-88) | aas | 5 |
| Mo (1991) | na | 5 |
| Cd | aas | 0.5 |
| As (1986) | aas | 20 |
| As (1988) | aas | 50 |
| As (1991) | na | 2 |
| Sb (1986) | aas | 5 |
| Sb (1991) | na | 0.2 |

Abbreviations: aas = atomic absorption spectrophotometry, fa/aas = fire assay/ atomic absorption spectrophotometry, na = neutron activation.

| NO. | MAP | ID | UTME | UTMN | AU | AG | CU | PB | ZN | MO | CD | AS | SB | SAMPLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 93L15 | DM86-16 | 643343 | 6076894 | -17 | -10.0 | 11.00 | 6.00 | 38.00 | 3 | | -20.0 | -10.0 | ALTERED VOLCANIC ROCK (FLOAT) |
| 2 | 93L15 | PD86-70 | 640806 | 6078547 | -17 | -10.0 | 13.00 | 11.00 | 51.00 | 6 | | -20.0 | -10.0 | ALTERED SILTSTONE |
| 3 | 93L15 | PD86-106-3 | 639696 | 6077050 | -17 | -10.0 | 34.00 | 12.00 | 70.00 | 4 | | 35.0 | -10.0 | ALTERED FELSIC TUFF |
| 4 | 93L15 | PD86-310 | 634580 | 6077560 | 105 | 1.0 | 25.00 | 31.00 | 123.00 | -5 | | 290.0 | -5.0 | ALTERED VOLCANIC ROCK |
| 5 | 93L15 | PD86-312 | 634485 | 6077253 | 137 | -0.6 | 20.00 | 18.00 | 452.00 | -5 | | -25.0 | -5.0 | ALTERED VOLCANIC ROCK |
| 6 | 93L15 | PD86-313 | 634287 | 6076865 | -20 | -0.6 | 146.00 | 7.00 | 61.00 | -5 | | -25.0 | -5.0 | ALTERED VOLCANIC ROCK |
| 7 | 93L15 | DM87-52 | 634435 | 6093371 | -20 | -0.5 | 23.00 | 12.00 | 50.00 | | | | | LIMONITIC/PYRITIC SCHIST |
| 8 | 93L15 | DM87-71 | 636271 | 6091672 | 40 | 0.8 | 9.00 | 5.00 | 20.00 | | | | | QUARTZ VEIN |
| 9 | 93L15 | DM87-80 | 638332 | 6089968 | 650 | 420.0 | 2200.00 | 8.00 | 107.00 | | | | | LIMONITIC SCHIST (MAL) |
| 10 | 93L15 | DM87-92 | 637657 | 6086782 | -20 | -0.5 | 17.00 | 8.00 | 112.00 | | | | | LIMONITIC SCHIST |
| 11 | 93L15 | DM87-93 | 633948 | 6085553 | -20 | 0.5 | 13.00 | 42.00 | 113.00 | | | | | QUARTZ VEIN |
| 12 | 93L15 | DM87-94 | 633934 | 6085891 | -20 | -0.5 | 9.00 | 12.00 | 72.00 | | | | | LIMONITIC SCHIST |
| 13 | 93L15 | DM87-99 | 632735 | 6086206 | -20 | -0.5 | 2.00 | 8.00 | 4.00 | | | | | LEACHED SCHIST |
| 14 | 93L15 | DM87-113-2 | 634426 | 6092178 | -20 | -0.5 | 26.00 | 51.00 | 69.00 | | | | | LIMONITIC TUFF |
| 15 | 93L15 | DM87-113-3 | 634426 | 6092178 | -20 | -0.5 | 37.00 | 18.00 | 56.00 | | | | | LIMONITIC TUFF |
| 16 | 93L15 | DM87-118 | 639763 | 6083909 | -20 | -0.5 | 7.00 | 25.00 | 40.00 | | | | | QUARTZ VEIN (FLOAT) |
| 17 | 93L15 | DM87-131-1 | 643885 | 6079468 | 494 | -0.5 | 6.00 | -5.00 | 393.00 | | | | | SILICIC VOLCANIC ROCK |
| 18 | 93L15 | DM87-131-2 | 643885 | 6079468 | -20 | -0.5 | 3.00 | -5.00 | 12.00 | | | | | SILICIC VOLCANIC ROCK |
| 19 | 93L15 | MC87-1 | 634550 | 6085600 | -20 | -0.5 | 19.00 | -5.00 | 111.00 | -5 | | | | LIMONITIC SCHIST |
| 20 | 93L15 | MC87-2 | 634600 | 6085650 | -20 | -0.5 | 27.00 | 23.00 | 108.00 | 7 | | | | LIMONITIC SCHIST |
| 21 | 93L15 | MC87-3 | 634700 | 6085850 | -20 | -0.5 | 10.00 | 12.00 | 70.00 | 10 | | | | LIMONITIC SCHIST |
| 22 | 93L15 | MC87-4 | 634700 | 6085850 | -20 | -0.5 | 50.00 | 16.00 | 71.00 | -5 | | | | LIMONITIC SCHIST |
| 23 | 93L15 | MC87-5 | 634720 | 6086300 | -20 | -0.5 | 52.00 | 11.00 | 50.00 | 5 | | | | LIMONITIC SCHIST |
| 24 | 93L15 | MC87-6-1 | 635000 | 6086300 | -20 | -0.5 | 41.00 | 20.00 | 65.00 | -5 | | | | LIMONITIC SCHIST |
| 25 | 93L15 | MC87-6-2 | 635150 | 6086570 | -20 | -0.5 | 18.00 | 21.00 | 64.00 | 5 | | | | LIMONITIC SCHIST |
| 26 | 93L15 | MC87-7-2 | 635950 | 6086200 | -20 | -0.5 | 41.00 | 15.00 | 114.00 | -5 | | | | LIMONITIC SCHIST |
| 27 | 93L15 | MC87-7-3 | 635700 | 6086200 | -20 | -0.5 | 30.00 | 11.00 | 59.00 | -5 | | | | LIMONITIC SCHIST |
| 28 | 93L15 | MC87-8-1 | 637000 | 6086650 | -20 | -0.5 | 17.00 | 12.00 | 61.00 | 7 | | | | LIMONITIC SCHIST |
| 29 | 93L15 | MC87-8-2 | 637000 | 6086650 | 20 | -0.5 | 48.00 | 10.00 | 55.00 | -5 | | | | LIMONITIC SCHIST |
| 30 | 93L15 | MC87-8-4 | 637000 | 6086650 | -20 | -0.5 | 13.00 | 18.00 | 58.00 | -5 | | | | LIMONITIC SCHIST |
| 31 | 93L15 | PD87-264-2 | 640800 | 6085219 | -20 | 0.4 | 20.00 | 91.00 | 230.00 | | | | | LIMONITIC SCHIST |
| 32 | 93L15 | PD87-270 | 637231 | 6084602 | 80 | -0.4 | 210.00 | 7.00 | 10.00 | | | | | LIMONITIC TUFF |
| 33 | 93L15 | PD87-277 | 636545 | 6083910 | -20 | -0.4 | 15.00 | 10.00 | 66.00 | | | | | ALTERED ANDESITE |
| 34 | 93L15 | PD87-282 | 634821 | 6086702 | -20 | -0.4 | 27.00 | 13.00 | 63.00 | | | | | ALTERED ANDESITE |
| 35 | 93L15 | PD87-284 | 634668 | 6086694 | 50 | -0.4 | 13.00 | 17.00 | 24.00 | | | | | PYRITIC SCHIST |
| 36 | 93L15 | PD87-287 | 634426 | 6087614 | -20 | 0.5 | 17.00 | 22.00 | 33.00 | | | | | PYRITIC SCHIST |
| 37 | 93L15 | PD87-290 | 634238 | 6087860 | 130 | -0.4 | 8.00 | 18.00 | 69.00 | | | | | PYRITIC SCHIST |
| 38 | 93L15 | PD87-330-2 | 634254 | 6094783 | -20 | -0.5 | 23.00 | 37.00 | 99.00 | -5 | | | | PYRITIC SCHIST |
| 39 | 93L15 | PD87-331-1 | 634317 | 6094816 | 90 | -0.5 | 28.00 | 56.00 | 85.00 | | | | | ALTERED ANDESITE |
| 40 | 93L15 | PD87-372-4 | 636959 | 6090176 | -20 | -0.5 | 32.00 | 13.00 | 150.00 | | | | | SILICIC/LIMONITIC SCHIST |
| 41 | 93L15 | PD87-372-6 | 636959 | 6090176 | -20 | -0.5 | 24.00 | 15.00 | 64.00 | | | | | LIMONITIC SCHIST |
| 42 | 93L15 | PD87-376-4 | 637378 | 6090779 | -20 | 4.0 | 3600.00 | 758.00 | 557.00 | | | | | LIMONITIC SCHIST (CPY, MAL) |
| 43 | 93L15 | PD87-383-2 | 637668 | 6088342 | -20 | 0.6 | 8.00 | 13.00 | 62.00 | | | | | LIMONITIC QUARTZ VEIN |

| NO. | MAP | ID | UTME | UTMN | AU | AG | CU | PB | ZN | MO | CD | AS | SB | SAMPLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44 | 93L15 | PD87-385 | 636217 | 6088304 | -20 | 0.7 | 6.00 | 15.00 | 66.00 | | | | | RHYOLITE |
| 45 | 93L15 | PD87-388-1 | 639065 | 6088218 | -20 | 3.0 | 106.00 | 123.00 | 335.00 | | | | | SERICITIC/LIMONITIC SCHIST |
| 46 | 93L15 | PD87-388-2 | 639065 | 6088218 | 90 | -0.5 | 3.00 | 8.00 | 32.00 | | | | | QUARTZ VEIN |
| 47 | 93L15 | PD87-402 | 633715 | 6088009 | -20 | 2.0 | 20.00 | 93.00 | 38.00 | | | | | PYRITIC SCHIST |
| 48 | 93L15 | PD87-403-2 | 633344 | 6088119 | -20 | 0.8 | 13.00 | 62.00 | 47.00 | | | | | PYRITIC ANDESITE |
| 49 | 93L15 | PD87-403-3 | 633344 | 6088119 | -20 | 0.5 | 2.00 | 12.00 | 12.00 | | | | | SILICIC ANDESITE |
| 50 | 93L15 | PD87-404 | 633214 | 6087767 | -20 | 0.6 | 15.00 | 33.00 | 63.00 | | | | | PYRITIC SCHIST |
| 51 | 93L15 | PD87-405-2 | 633118 | 6087805 | -20 | -0.5 | 2.00 | 10.00 | 3.00 | | | | | SILICIC VOLCANIC ROCK |
| 52 | 93L15 | PD87-409 | 632768 | 6087284 | -20 | -0.5 | 9.00 | 10.00 | 90.00 | | | | | PYRITIC SCHIST |
| 53 | 93L15 | PD87-410 | 632642 | 6087111 | -20 | -0.5 | 28.00 | 12.00 | 112.00 | | | | | ALTERED PYRITIC ANDESITE |
| 54 | 93L15 | PD87-411 | 632430 | 6086713 | -20 | -0.5 | 15.00 | 12.00 | 22.00 | | | | | LIMONITIC SCHIST |
| 55 | 93L15 | PD87-412 | 632312 | 6086482 | -20 | -0.5 | 11.00 | 15.00 | 56.00 | | | | | ALTERED BASALT |
| 56 | 93L15 | PD87-413-1 | 632212 | 6086303 | -20 | -0.5 | 13.00 | 12.00 | 47.00 | | | | | QUARTZ VEIN |
| 57 | 93L15 | PD87-413-2 | 632212 | 6086303 | -20 | -0.5 | 10.00 | 12.00 | 214.00 | | | | | SERICITIC/LIMONITIC SCHIST |
| 58 | 93L15 | PD87-421-4 | 630400 | 6088200 | -20 | -0.5 | 24.00 | 22.00 | 155.00 | 18 | | | | LIMONITIC SCHIST |
| 59 | 93L15 | PD87-421-6 | 630400 | 6088200 | -20 | -0.5 | 21.00 | 12.00 | 36.00 | -5 | | | | LIMONITIC SCHIST |
| 60 | 93L15 | PD421-7 | 630400 | 6088200 | -20 | -0.5 | 8.00 | 11.00 | 25.00 | 5 | | | | LIMONITIC SCHIST |
| 61 | 93L15 | PD87-421-8 | 630400 | 6088200 | -20 | -0.5 | 12.00 | 18.00 | 52.00 | -5 | | | | LIMONITIC SCHIST |
| 62 | 93L15 | PD87-425 | 631000 | 6088900 | -20 | -0.5 | 13.00 | 13.00 | 42.00 | -5 | | | | PYRITIC SCHIST |
| 63 | 93L15 | PD87-426 | 631700 | 6089300 | -20 | -0.5 | 15.00 | 11.00 | 39.00 | -5 | | | | PYRITIC SCHIST |
| 64 | 93L15 | PD87-428-3 | 633878 | 6090672 | -20 | -0.5 | 26.00 | 13.00 | 84.00 | -5 | | | | LIMONITIC SCHIST |
| 65 | 93L15 | PD87-429-1 | 633879 | 6090609 | -20 | -0.5 | 41.00 | 101.00 | 141.00 | 5 | | | | LIMONITIC SCHIST |
| 66 | 93L15 | PD87-458-4 | 631969 | 6094379 | -20 | -0.5 | 19.00 | 19.00 | 63.00 | -5 | | | | PYRITIC SCHIST |
| 67 | 93L15 | PD87-459 | 631913 | 6094233 | -20 | -0.5 | 35.00 | 19.00 | 54.00 | -5 | | | | QUARTZ VEIN |
| 68 | 93L15 | PD87-460-2 | 631888 | 6094163 | -20 | -0.5 | 31.00 | 12.00 | 81.00 | 8 | | | | ALTERED TUFF |
| 69 | 93L15 | PD87-480 | 629380 | 6087149 | -20 | -0.5 | 15.00 | 16.00 | 80.00 | 5 | | | | ALTERED TUFF |
| 70 | 93L15 | PD87-484-2 | 630103 | 6090150 | -20 | 1.0 | 6.00 | 130.00 | 70.00 | -5 | | | | QUARTZ VEIN |
| 71 | 93L15 | PD87-484-4 | 630103 | 6090150 | -20 | 0.5 | 21.00 | 47.00 | 135.00 | 5 | | | | PYRITIC SILTSTONE |
| 72 | 93L15 | PD87-489 | 635695 | 6085373 | -20 | -0.5 | 19.00 | 16.00 | 54.00 | 9 | | | | LIMONITIC SCHIST |
| 73 | 93L15 | PD87-491-2 | 635832 | 6084936 | -20 | -0.5 | 21.00 | 10.00 | 76.00 | -5 | | | | ALTERED TUFF |
| 74 | 93L15 | PD87-506-4 | 636379 | 6087668 | -20 | -0.5 | 4.00 | 13.00 | 105.00 | 6 | | | | ALTERED ANDESITE |
| 75 | 93L15 | PD87-506-5 | 636379 | 6087668 | -20 | -0.5 | 3.00 | 9.00 | 32.00 | 15 | | | | ALTERED VOLCANIC ROCK (FLOAT) |
| 76 | 93L15 | PD87-510-2 | 636838 | 6086520 | -20 | -0.5 | 7.00 | 73.00 | 19.00 | 6 | | | | LIMONITIC SCHIST |
| 77 | 93L15 | PD87-510-3 | 636838 | 6086520 | -20 | -0.5 | 33.00 | 12.00 | 58.00 | -5 | | | | LIMONITIC SCHIST |
| 78 | 93L15 | PD87-514 | 636319 | 6086198 | 120 | -0.5 | 7.00 | 54.00 | 21.00 | 5 | | | | SILICIC VOLCANIC ROCK |
| 79 | 93L15 | PD87-533-2 | 640757 | 6086258 | -20 | 1.0 | 90.00 | 29.00 | 240.00 | -5 | | | | ALTERED RHYOLITE |
| 80 | 93L15 | PD87-539-3 | 639910 | 6086528 | 1410 | 2.0 | 59.00 | 15.00 | 79.00 | -5 | | | | PY-RHYOLITE (RHYOLITE SHOWING) |
| 81 | 93L15 | PD87-539-4 | 639910 | 6086528 | 4320 | 2.0 | 37.00 | 25.00 | 90.00 | -5 | | | | PY SCHIST (RHYOLITE SHOWING) |
| 82 | 93L15 | PD87-545-1 | 636365 | 6092412 | -20 | 0.5 | 51.00 | 12.00 | 102.00 | -5 | | | | SERICITIC/PYRITIC SCHIST |
| 83 | 93L15 | PD87-545-4 | 636258 | 6092297 | -20 | -0.5 | 38.00 | 16.00 | 78.00 | 8 | | | | LIMONITIC SCHIST |
| 84 | 93L15 | PD87-545-5 | 636258 | 6092297 | -20 | -0.5 | 35.00 | 18.00 | 110.00 | -5 | | | | LIMONITIC SCHIST |
| 85 | 93L15 | PD87-560 | 641142 | 6085644 | -20 | -0.5 | 4.00 | 17.00 | 226.00 | -5 | | | | QUARTZ VEIN |
| 86 | 93L15 | PD87-570 | 642173 | 6084281 | -20 | 0.5 | 23.00 | 27.00 | 75.00 | -5 | | | | LIMONITIC SCHIST |

| NO. | MAP | ID | UTME | UTMN | AU | AG | CU | PB | ZN | MO | CD | AS | SB | SAMPLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 87 | 93L15 | PD87-563-4 | 640223 | 6084971 | -20 | -0.5 | 5.00 | -5.00 | 16.00 | -5 | | | | LIMONITIC SCHIST |
| 88 | 93L14 | DMA88-14-2 | 627159 | 6089343 | 1 | 0.5 | 8.00 | 13.00 | 10.00 | | | -50.0 | -15.0 | QUARTZ VEIN |
| 89 | 93L14 | DMA88-17 | 627233 | 6087847 | 1510 | 59.0 | 286.00 | 5100.00 | 5900.00 | | | 1100.0 | 320.0 | QUARTZ VEIN (AG SHOWING) |
| 90 | 93L15 | DMA88-44 | 643885 | 6079468 | 21 | -0.5 | 30.00 | 84.00 | 310.00 | -8 | | | -25.0 | ALTERED VOLCANIC ROCK |
| 91 | 93L15 | DMA88-45 | 643163 | 6078388 | 2 | -0.5 | 33.00 | 5.00 | 68.00 | -8 | | | -25.0 | ALTERED VOLCANIC ROCK |
| 92 | 93L14 | MCU88-3 | 627111 | 6090226 | 1 | -0.5 | 2.00 | 42.00 | 23.00 | | | -50.0 | -15.0 | QUARTZ VEIN |
| 93 | 93L14 | MCU88-4 | 627155 | 6091231 | 1 | -0.5 | 117.00 | 9.00 | 220.00 | | | -50.0 | -15.0 | ALTERED VOLCANIC ROCK |
| 94 | 93L14 | MCU88-5 | 627212 | 6090224 | 1 | -0.5 | 3.00 | 7.00 | 12.00 | | | -50.0 | -15.0 | QUARTZ VEIN |
| 95 | 93M03 | MCU88-6 | 626231 | 6097211 | 8 | -0.5 | 47.00 | 34.00 | 108.00 | | | 140.0 | -15.0 | SANDSTONE |
| 96 | 93M03 | MCU88-7 | 627243 | 6097442 | 1 | -0.5 | 37.00 | 17.00 | 80.00 | | | -50.0 | -15.0 | SANDSTONE |
| 97 | 93L15 | PDE88-2 | 642217 | 6077572 | 3 | -0.5 | 3.00 | 7.00 | 31.00 | | | -50.0 | -15.0 | QUARTZ VEIN |
| 98 | 93L15 | PDE88-3-1 | 643156 | 6078466 | 1 | -0.5 | 17.00 | 10.00 | 86.00 | | | -50.0 | -15.0 | ALTERED VOLCANIC ROCK |
| 99 | 93L15 | PDE88-3-2 | 643885 | 6079468 | 29 | -0.6 | 12.00 | 9.00 | 87.00 | | | | | SILTSTONE |
| 100 | 93L15 | PDE88-12-2 | 643884 | 6081941 | 1 | -0.5 | 59.00 | 5.00 | 148.00 | | | -50.0 | -15.0 | ALTERED VOLCANIC ROCK |
| 101 | 93L15 | PDE88-19 | 644656 | 6082808 | 2 | -0.5 | 2.00 | 39.00 | 60.00 | | | -50.0 | -15.0 | QUARTZ VEIN |
| 102 | 93L15 | PDE88-86 | 643704 | 6088761 | 1 | -0.5 | 197.00 | 15.00 | 148.00 | | | -50.0 | -15.0 | ALTERED VOLCANIC ROCK |
| 103 | 93L15 | PDE88-90-1 | 643087 | 6089985 | 2 | -0.5 | 34.00 | 29.00 | 218.00 | | | -50.0 | -15.0 | ALTERED VOLCANIC ROCK |
| 104 | 93L15 | PDE88-96 | 643366 | 6090511 | 2 | -0.5 | 143.00 | 7.00 | 50.00 | | | -50.0 | -15.0 | ALTERED VOLCANIC ROCK |
| 105 | 93L15 | PDE88-99 | 643854 | 6090217 | 1 | -0.5 | 7.00 | 15.00 | 138.00 | | | -50.0 | -15.0 | ALTERED VOLCANIC ROCK |
| 106 | 93L14 | PDE88-166 | 626559 | 6090623 | 2 | -0.5 | 59.00 | 14.00 | 74.00 | | | -50.0 | -15.0 | ALTERED VOLCANIC ROCK |
| 107 | 93L14 | PDE88-184 | 623637 | 6093727 | 1 | -0.5 | 22.00 | 13.00 | 77.00 | | | -50.0 | -15.0 | SANDSTONE |
| 108 | 93L14 | PDE88-190 | 622353 | 6093935 | 1 | -0.5 | 73.00 | 48.00 | 78.00 | | | -50.0 | -15.0 | SANDSTONE |
| 109 | 93L14 | PDE88-192 | 622612 | 6094203 | 2 | -0.5 | 52.00 | 9.00 | 120.00 | | | -50.0 | -15.0 | ALTERED VOLCANIC ROCK |
| 110 | 93L14 | PDE88-193 | 622656 | 6094235 | 4 | -0.5 | 150.00 | 165.00 | 253.00 | | | 72.0 | -15.0 | QUARTZ VEIN |
| 111 | 93L14 | PDE88-198 | 621528 | 6096058 | 4 | -0.5 | 26.00 | 17.00 | 82.00 | | | -50.0 | -15.0 | SILTSTONE |
| 112 | 93L14 | PDE88-199 | 621497 | 6096013 | 112 | -0.5 | 17.00 | 24.00 | 68.00 | | | -50.0 | -15.0 | QUARTZ VEIN |
| 113 | 93L14 | PDE88-209 | 620858 | 6094923 | 2 | -0.5 | 40.00 | 17.00 | 118.00 | | | -50.0 | -15.0 | SILTSTONE |
| 114 | 93L14 | PDE88-213 | 621133 | 6093758 | 6 | 2.0 | 2300.00 | 17.00 | 248.00 | | | -50.0 | 337.0 | QUARTZ VEIN |
| 115 | 93L15 | PDE88-264-3 | 643503 | 6091209 | 14 | 0.6 | 9.00 | 3.00 | 24.00 | | | | -25.0 | TUFF |
| 116 | 93L14 | PTE88-129 | 620505 | 6091751 | | 1.0 | 14.00 | 60.00 | 33.00 | | | -50.0 | -15.0 | QUARTZ VEIN |
| 117 | 93L15 | APE88-2 | 643885 | 6079468 | 37 | -0.6 | 3.00 | 5.00 | 27.00 | | | | | SILTSTONE |
| 118 | 93L15 | APE88-3 | 643885 | 6079468 | 33 | -0.6 | 4.00 | 5.00 | 29.00 | | | | | SILTSTONE |
| 119 | 93L15 | APE88-4 | 643885 | 6079468 | 37 | -0.6 | 5.00 | 7.00 | 147.00 | | | | | SILTSTONE |
| 120 | 93M02 | BGA91-1 | 631158 | 6098542 | 6 | -0.5 | 19.00 | 7.00 | 60.00 | -5 | -0.3 | 8.0 | 5.5 | ALTERED ANDESITE |
| 121 | 93M02 | BGA91-2 | 630995 | 6098571 | -5 | -0.5 | 32.00 | 7.00 | 63.00 | -5 | -0.3 | 5.0 | 1.6 | ALTERED ANDESITE |
| 122 | 93M02 | BGA91-3 | 631331 | 6098470 | -5 | -0.5 | 28.00 | 3.00 | 88.00 | -5 | -0.3 | 3.0 | 0.4 | LIMONITIC ANDESITE |
| 123 | 93M02 | BGA91-4 | 631391 | 6098419 | -5 | -0.5 | 8.00 | 11.00 | 131.00 | -5 | 0.4 | 9.0 | 14.0 | ALTERED ANDESITE |
| 124 | 93M02 | BGA91-5 | 631381 | 6098647 | -5 | -0.5 | 46.00 | 9.00 | 133.00 | 7 | 0.4 | 25.0 | 0.6 | LIMONITIC ANDESITE |
| 125 | 93M02 | BGA91-6 | 631224 | 6098838 | 5 | -0.5 | 9.00 | 8.00 | 85.00 | 5 | -0.3 | 10.0 | 19.0 | QUARTZ-VEINED ANDESITE |
| 126 | 93M02 | BGA91-7 | 631711 | 6098203 | -5 | -0.5 | 49.00 | 8.00 | 81.00 | -5 | -0.3 | 8.0 | 2.6 | LIMONITIC ANDESITE |
| 127 | 93M02 | BGA91-8 | 631711 | 6098203 | -5 | -0.5 | 13.00 | 13.00 | 33.00 | -5 | -0.3 | 4.0 | 1.6 | ALTERED ANDESITE |
| 128 | 93M02 | BGA91-9 | 631710 | 6098203 | -5 | -0.5 | 24.00 | 12.00 | 50.00 | -5 | -0.3 | 8.0 | 2.3 | EPIDOTE-ALTERED ANDESITE |
| 129 | 93M02 | BGA91-10 | 631818 | 6098217 | -5 | -0.5 | 27.00 | 8.00 | 72.00 | -5 | -0.3 | 3.0 | 0.5 | ANKERITE-VEINED ANDESITE |

| NO. | MAP | ID | UTME | UTMN | AU | AG | CU | PB | ZN | MO | CD | AS | SB | SAMPLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 130 | 93M02 | BGA91-11 | 631917 | 6098244 | -5 | -0.5 | 6.00 | 12.00 | 132.00 | -5 | -0.3 | 9.0 | 33.0 | QTZ-ANK VEINED ANDESITE |
| 131 | E3M02 | BGA91-12 | 632048 | 6098281 | -5 | -0.5 | 12.00 | 11.00 | 145.00 | -5 | 0.3 | 2.0 | 1.9 | LIMONITIC ANDESITE |
| 132 | 93M02 | BGA91-13 | 632033 | 6098357 | -5 | -0.5 | 122.00 | 14.00 | 52.00 | -5 | 1.7 | 5.0 | 5.1 | LIMONITIC ANDESITE |
| 133 | 93M02 | BGA91-14 | 632077 | 6098490 | -5 | -0.5 | 6.00 | 8.00 | 58.00 | -5 | -0.3 | 6.0 | 14.0 | CHLORITIC ANDESITE |
| 134 | 93M02 | BGA91-15 | 631983 | 6098457 | 5 | -0.5 | 57.00 | 10.00 | 112.00 | -5 | -0.3 | 4.0 | 0.6 | LIMONITIC ANDESITE |
| 135 | 93L15 | BGA91-16 | 636832 | 6086736 | 10 | -0.5 | 12.00 | 18.00 | 12.00 | -5 | -0.3 | 16.0 | 3.1 | LIMONITIC SCHIST |
| 136 | 93L15 | BGA91-17 | 636878 | 6086495 | -5 | -0.5 | 17.00 | 15.00 | 25.00 | -5 | -0.3 | 12.0 | 1.5 | SERICITIC/PYRITIC SCHIST |
| 137 | 93L15 | BGA91-18 | 636429 | 6086130 | -5 | -0.5 | 8.00 | 7.00 | 16.00 | -5 | -0.3 | 9.0 | 1.9 | LIMONITIC QUARTZ VEIN |
| 138 | 93L15 | BGA91-19 | 636432 | 6086131 | -5 | -0.5 | 14.00 | 10.00 | 168.00 | -5 | -0.3 | 25.0 | 5.0 | PYRITIC SCHIST |
| 139 | 93L15 | BGA91-20 | 636419 | 6086047 | -5 | -0.5 | 2.00 | 7.00 | 13.00 | -5 | 0.3 | 5.0 | 1.1 | LIMONITIC QUARTZ VEIN |
| 140 | 93L15 | BGA91-21 | 636424 | 6086045 | -5 | -0.5 | 16.00 | 9.00 | 49.00 | -5 | -0.3 | 6.0 | 3.5 | SERICITE SCHIST |
| 141 | 93L15 | BGA91-22 | 636476 | 6085986 | -5 | -0.5 | 24.00 | 15.00 | 19.00 | -5 | -0.3 | 10.0 | 6.1 | PYRITIC SCHIST |
| 142 | 93L15 | BGA91-23 | 636345 | 6085887 | -5 | -0.5 | 21.00 | 10.00 | 30.00 | -5 | -0.3 | 31.0 | 2.3 | PYRITIC SCHIST |
| 143 | 93L15 | BGA91-24 | 636290 | 6085898 | -5 | -0.5 | 35.00 | 35.00 | 49.00 | 5 | -0.3 | 34.0 | 6.0 | PYRITIC SCHIST |
| 144 | 93L15 | BGA91-25 | 634341 | 6085951 | -5 | -0.5 | 4.00 | 3.00 | 8.00 | -5 | 0.4 | 15.0 | 1.0 | QUARTZ VEIN |
| 145 | 93L15 | BGA91-26 | 633932 | 6085950 | -5 | -0.5 | 14.00 | 15.00 | 93.00 | -5 | -0.3 | 15.0 | 0.9 | LIMONITIC SCHIST |
| 146 | 93L15 | BGA91-27 | 633892 | 6085838 | -5 | -0.5 | 12.00 | 5.00 | 34.00 | -5 | -0.3 | 15.0 | 8.1 | LIMONITIC SCHIST |
| 147 | 93L15 | BGA91-28 | 633984 | 6085800 | -5 | -0.5 | 19.00 | 7.00 | 22.00 | -5 | -0.3 | 5.0 | 1.8 | LIM-ANK QUARTZ VEIN |
| 148 | 93L15 | BGA91-29 | 634040 | 6085794 | 12 | -0.5 | 20.00 | 7.00 | 61.00 | -5 | -0.3 | 14.0 | 2.4 | LIMONITIC SCHIST |
| 149 | 93L15 | BGA91-30 | 634145 | 6085734 | -5 | -0.5 | 39.00 | 21.00 | 136.00 | -5 | -0.3 | 27.0 | 8.8 | LIMONITIC SCHIST |
| 150 | 93L15 | BGA91-31 | 634269 | 6085957 | -5 | -0.5 | 9.00 | 9.00 | 20.00 | -5 | -0.3 | 23.0 | 1.7 | LIMONITIC-SILICIC SCHIST |
| 151 | 93L15 | BGA91-32 | 634214 | 6085731 | -5 | -0.5 | 9.00 | 7.00 | 33.00 | -5 | -0.3 | 6.0 | 4.4 | LIMONITIC-SILICIC SCHIST |
| 152 | 93L15 | BGA91-33 | 634290 | 6085828 | -5 | 0.7 | 9.00 | 240.00 | 76.00 | -5 | -0.3 | 36.0 | 6.4 | BLEACHED PHYLLITE |
| 153 | 93L15 | BGA91-34 | 634378 | 6085868 | -5 | -0.5 | 7.00 | -3.00 | 16.00 | -5 | -0.3 | 13.0 | 0.5 | LIMONITIC QUARTZ VEIN |
| 154 | 93L15 | BGA91-35 | 634412 | 6085837 | -5 | -0.5 | 11.00 | 25.00 | 50.00 | -5 | -0.3 | 44.0 | 6.2 | LIMONITIC SCHIST |
| 155 | 93L15 | BGA91-36 | 634488 | 6085838 | -5 | -0.5 | 28.00 | 25.00 | 65.00 | -5 | -0.3 | 59.0 | 4.7 | LIMONITIC SCHIST |
| 156 | 93L15 | BGA91-37 | 634569 | 6085794 | -5 | -0.5 | 11.00 | 16.00 | 166.00 | -5 | -0.3 | 47.0 | 3.4 | LIMONITIC-SILICIC PHYLLITE |
| 157 | 93M02 | BGA91-38 | 631508 | 6096903 | 26 | -0.5 | 12.00 | 18.00 | 68.00 | -5 | -0.3 | 23.0 | 3.8 | SILICIC ANDESITE |
| 158 | 93M02 | BGA91-39 | 630785 | 6100080 | -5 | -0.5 | 17.00 | 6.00 | 46.00 | -5 | -0.3 | 4.0 | 0.9 | CARBONATE-ALTERED ANDESITE |
| 159 | 93L15 | BGA91-40 | 634835 | 6087778 | 8 | 0.4 | 16.00 | 23.00 | 170.00 | -5 | -0.3 | 26.0 | 2.9 | LIMONITIC ANDESITE |
| 160 | 93L15 | BGA91-41 | 634733 | 6087833 | -5 | -0.4 | 10.00 | 6.00 | 11.00 | -5 | 0.3 | 7.0 | 1.1 | QUARTZ VEIN (SPEC) |
| 161 | 93L15 | BGA91-42 | 634735 | 6087832 | -5 | -0.4 | 12.00 | 3.00 | 193.00 | -5 | 3.4 | 8.0 | 1.6 | QUARTZ VEIN (SPEC) |
| 162 | 93L15 | BGA91-43 | 634721 | 6087834 | -5 | -0.4 | 11.00 | 3.00 | 10.00 | -5 | 0.3 | 8.0 | 1.1 | QUARTZ VEIN (SPEC) |
| 163 | 93L15 | BGA91-44 | 633948 | 6087892 | 11 | 16.0 | 564.00 | 15900.00 | 370.00 | -5 | 13.0 | 11.0 | 12.0 | SILVER KING LAKE SHOWING/VEIN |
| 164 | 93L15 | BGA91-45 | 633879 | 6087943 | -5 | -0.4 | 18.00 | 21.00 | 41.00 | -5 | -0.3 | 37.0 | 1.7 | LIMONITIC SCHIST |
| 165 | 93L15 | BGA91-46 | 633850 | 6087885 | -5 | -0.4 | 14.00 | 9.00 | 40.00 | -5 | 0.3 | 36.0 | 2.1 | LIMONITIC SCHIST |
| 166 | 93L15 | BGA91-47 | 633779 | 6087869 | -5 | 0.4 | 20.00 | 12.00 | 59.00 | -5 | -0.3 | 72.0 | 2.4 | LIMONITIC/PYRITIC SCHIST |
| 167 | 93L15 | BGA91-48 | 633891 | 6088163 | -5 | 1.3 | 17.00 | 11.00 | 15.00 | 7 | -0.3 | 53.0 | 5.0 | PYRITIC RHYOLITE |
| 168 | 93L15 | BGA91-49 | 633891 | 6088163 | -5 | -0.4 | 19.00 | 12.00 | 17.00 | 8 | -0.3 | 35.0 | 3.1 | PYRITIC RHYOLITE |
| 169 | 93L15 | BGA91-50 | 633787 | 6087950 | -5 | 0.4 | 34.00 | 15.00 | 13.00 | -5 | -0.3 | 120.0 | 1.5 | PYRITIC/LIMONITIC ANDESITE |
| 170 | 93L15 | BGA91-51 | 633700 | 6087986 | -5 | 1.2 | 24.00 | 17.00 | 10.00 | 9 | -0.3 | 230.0 | 5.1 | LIMONITIC SCHIST |
| 171 | 93L15 | BGA91-52 | 633214 | 6087881 | -5 | -0.4 | 17.00 | 5.00 | 107.00 | -5 | -0.3 | 170.0 | 1.3 | PYRITIC/LIMONITIC ANDESITE |
| 172 | 93L15 | BGA91-53 | 633876 | 6087957 | -5 | -0.4 | 21.00 | -3.00 | 83.00 | -5 | -0.3 | 10.0 | 0.7 | RIBBONED QUARTZ VEIN |

| NO. | MAP | ID | UTME | UTMN | AU | AG | CU | PB | ZN | MO | CD | AS | SB | SAMPLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 173 | 93L15 | BGA91-54 | 632725 | 6087242 | -5 | -0.4 | 25.00 | 14.00 | 69.00 | -5 | -0.3 | 28.0 | 1.9 | SERICITE-CHLORITE SCHIST |
| 174 | 93L15 | BGA91-55 | 632626 | 6087143 | -5 | -0.4 | 20.00 | 9.00 | 140.00 | -5 | -0.3 | 34.0 | 4.8 | CHLORITE-SERICITE SCHIST |
| 175 | 93L15 | BGA91-56 | 632677 | 6087083 | 9 | -0.4 | 16.00 | 8.00 | 100.00 | -5 | -0.3 | 62.0 | 11.0 | PYRITIC ANDESITE |
| 176 | 93L15 | BGA91-57 | 632629 | 6086751 | -5 | -0.4 | 16.00 | 9.00 | 70.00 | -5 | -0.3 | 28.0 | 1.2 | PYRITIC SCHIST |
| 177 | 93L15 | BGA91-58 | 632597 | 6086698 | -5 | -0.4 | 22.00 | 8.00 | 86.00 | -5 | -0.3 | 23.0 | 1.3 | PYRITIC SER-CHLOR SCHIST |
| 178 | 93L15 | BGA91-59 | 632472 | 6086430 | -5 | -0.4 | 9.00 | 11.00 | 7.00 | -5 | -0.3 | 22.0 | 3.0 | PYRITIC SERICITE SCHIST |
| 179 | 93L15 | BGA91-60 | 632486 | 6086351 | -5 | -0.4 | 19.00 | 8.00 | 84.00 | -5 | -0.3 | 21.0 | 1.7 | PYRITIC SERICITE SCHIST |
| 180 | 93L15 | BGA91-61 | 634406 | 6092181 | -5 | -0.4 | 25.00 | 8.00 | 41.00 | 5 | -0.3 | 17.0 | 0.6 | SILICIC ANDESITE |
| 181 | 93L15 | BGA91-62 | 634399 | 6092090 | 5 | -0.4 | 17.00 | 8.00 | 62.00 | -5 | -0.3 | 4.0 | -0.2 | SILICIC ANDESITE |
| 182 | 93L15 | BGA91-63 | 634054 | 6092575 | -5 | -0.4 | 25.00 | 11.00 | 51.00 | -5 | -0.3 | 3.0 | 0.3 | SILICIC ANDESITE |
| 183 | 93L15 | BGA91-64 | 633673 | 6092915 | -5 | -0.4 | 68.00 | 11.00 | 110.00 | -5 | -0.3 | 8.0 | 0.4 | SILICIC ANDESITE |
| 184 | 93L15 | BGA91-65 | 633518 | 6092959 | -5 | -0.4 | 24.00 | 8.00 | 60.00 | -5 | -0.3 | 18.0 | 2.3 | SILICIC ANDESITE |
| 185 | 93L15 | BGA91-66 | 639757 | 6081859 | 8 | -0.4 | 18.00 | 8.00 | 90.00 | -5 | -0.3 | 5.0 | 1.5 | PYRITIC ANDESITE |
| 186 | 93L15 | BGA91-67 | 639870 | 6081851 | -5 | -0.4 | 47.00 | 14.00 | 225.00 | -5 | 4.1 | 3.0 | 0.7 | RIBBONED QUARTZ VEIN |
| 187 | 93L15 | BGA91-68 | 639921 | 6081862 | -5 | -0.4 | 17.00 | 5.00 | 44.00 | -5 | -0.3 | 2.0 | 0.8 | LIMONITIC QUARTZ VEIN |
| 188 | 93L15 | BGA91-69 | 639981 | 6081885 | -5 | -0.4 | 14.00 | 5.00 | 36.00 | -5 | 0.3 | -2.0 | 1.6 | LIMONITIC QUARTZ VEIN |
| 189 | 93L15 | BGA91-70 | 640046 | 6081934 | -5 | -0.4 | 8.00 | 8.00 | 54.00 | -5 | -0.3 | 4.0 | 0.9 | LIMONITIC QUARTZ VEIN |
| 190 | 93L15 | BGA91-71 | 640090 | 6081979 | -5 | -0.4 | 5.00 | 9.00 | 28.00 | -5 | 0.3 | 2.0 | 1.4 | LIMONITIC QUARTZ VEIN |
| 191 | 93L15 | BGA91-72 | 640119 | 6082007 | -5 | -0.4 | 16.00 | 17.00 | 35.00 | -5 | -0.3 | 10.0 | 1.7 | LIMONITIC QUARTZ VEIN |
| 192 | 93L15 | BGA91-73 | 640313 | 6082042 | -5 | 0.4 | 19.00 | 18.00 | 163.00 | -5 | 1.0 | 3.0 | 3.9 | LIMONITIC SCHIST |
| 193 | 93L15 | BGA91-74 | 640522 | 6082037 | 5 | 10.0 | 66.00 | 4050.00 | 3800.00 | -5 | 22.0 | 8.0 | 220.0 | 74-77 LITTLE JOE LAKE S VEINS |
| 194 | 93L15 | BGA91-75 | 640521 | 6082031 | -5 | 0.4 | 16.00 | 18.00 | 163.00 | -5 | 0.6 | -2.0 | 20.0 | QUARTZ VEIN |
| 195 | 93L15 | BGA91-76 | 640521 | 6082032 | -12 | 32.0 | 163.00 | 25300.00 | 1350.00 | -5 | 10.0 | -2.0 | 1400.0 | QUARTZ VEIN |
| 196 | 93L15 | BGA91-77 | 640522 | 6082034 | -5 | 0.6 | 4.00 | 16.00 | 39.00 | -5 | -0.3 | 3.0 | 2.5 | QUARTZ VEIN |
| 197 | 93L15 | BGA91-78 | 640246 | 6082036 | -5 | -0.4 | 20.00 | 15.00 | 60.00 | -5 | -0.3 | 14.0 | 1.9 | QUARTZ VEIN |
| 198 | 93L15 | BGA91-79 | 640356 | 6082007 | -5 | -0.4 | 16.00 | 39.00 | 66.00 | -5 | 0.5 | -2.0 | 2.3 | LIMONITIC QUARTZ VEIN |
| 199 | 93L15 | BGA91-80 | 640387 | 6082013 | -5 | -0.4 | 3.00 | 27.00 | 23.00 | -5 | 0.3 | -2.0 | 1.7 | LIMONITIC QUARTZ VEIN |
| 200 | 93L15 | BGA91-81 | 640414 | 6082028 | -5 | -0.4 | 3.00 | 11.00 | 15.00 | -5 | 0.3 | 3.0 | 1.5 | LIMONITIC QUARTZ VEIN |
| 201 | 93L15 | BGA91-82 | 640471 | 6082032 | -5 | -0.4 | 11.00 | 19.00 | 71.00 | -5 | -0.3 | 4.0 | 4.2 | 82-90 LITTLE JOE LAKE S VEINS |
| 202 | 93L15 | BGA91-83 | 640515 | 6082028 | -38 | 17.0 | 413.00 | 18300.00 | 10700.00 | -7 | 60.0 | 110.0 | 4100.0 | QUARTZ VEIN |
| 203 | 93L15 | BGA91-84 | 640516 | 6082030 | -36 | 28.0 | 73.00 | 18000.00 | 2650.00 | -9 | 22.0 | -8.0 | 5600.0 | QUARTZ VEIN |
| 204 | 93L15 | BGA91-85 | 640575 | 6082018 | -5 | -0.4 | 4.00 | 15.00 | 34.00 | -5 | -0.3 | 4.0 | 2.1 | QUARTZ VEIN |
| 205 | 93L15 | BGA91-86 | 640575 | 6082018 | 12 | 0.6 | 15.00 | 30.00 | 83.00 | 10 | 0.5 | 15.0 | 3.1 | QUARTZ VEIN |
| 206 | 93L15 | BGA91-87 | 640575 | 6082018 | -5 | 0.4 | 19.00 | 63.00 | 70.00 | -5 | 0.4 | 4.0 | 1.7 | QUARTZ VEIN |
| 207 | 93L15 | BGA91-88 | 640573 | 6082017 | -5 | 0.4 | 53.00 | 66.00 | 22.00 | -5 | 0.3 | 3.0 | 3.4 | QUARTZ VEIN |
| 208 | 93L15 | BGA91-89 | 640573 | 6082017 | -5 | -0.4 | 3.00 | 66.00 | 57.00 | -5 | 0.3 | -2.0 | 2.3 | QUARTZ VEIN |
| 209 | 93L15 | BGA91-90 | 640516 | 6082034 | -5 | 95.0 | 112.00 | 82500.00 | 1400.00 | -5 | 11.0 | -2.0 | 580.0 | QUARTZ VEIN |
| 210 | 93L15 | BGA91-91 | 641351 | 6081206 | -2 | 0.4 | 2.00 | 5.00 | 10.00 | 2 | -0.3 | 1.0 | 0.3 | LIMONITIC QUARTZ VEIN |
| 211 | 93L15 | BGA91-92 | 641348 | 6081205 | -2 | -0.4 | 3.00 | 6.00 | 29.00 | 1 | -0.3 | 6.5 | 1.0 | PYRITIC RHYOLITE |
| 212 | 93L15 | BGA91-93 | 641265 | 6081092 | -2 | -0.4 | 3.00 | 5.00 | 26.00 | 3 | -0.3 | 1.5 | 0.4 | RIBBONED QUARTZ VEIN |
| 213 | 93L15 | BGA91-94 | 641143 | 6080872 | -2 | -0.4 | 5.00 | 15.00 | 33.00 | 2 | -0.3 | 10.0 | 2.1 | QUARTZ VEIN |
| 214 | 93L15 | BGA91-95 | 640697 | 6082011 | 26 | 11.0 | 53.00 | 6000.00 | 3550.00 | 4 | 31.0 | 2.9 | 8.7 | 95-103 LITTLE JOE LAKE S VEINS |
| 215 | 93L15 | BGA91-96 | 640697 | 6082011 | 15 | 6.0 | 110.00 | 1800.00 | 34000.00 | -1 | 300.0 | 2.0 | 6.7 | QUARTZ VEIN |

| NO. | MAP | ID | UTME | UTMN | AU | AG | CU | PB | ZN | MO | CD | AS | SB | SAMPLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 216 | 93L15 | BGA91-97 | 640694 | 6082012 | -2 | 0.4 | 9.00 | 228.00 | 98.00 | 4 | 1.5 | 2.1 | 2.7 | QUARTZ VEIN |
| 217 | 93L15 | BGA91-98 | 640705 | 6081949 | -2 | 2.0 | 10.00 | 687.00 | 470.00 | -1 | 3.0 | 1.9 | 5.8 | QUARTZ VEIN |
| 218 | 93L15 | BGA91-99 | 640706 | 6081950 | 2 | 6.0 | 36.00 | 869.00 | 1200.00 | -1 | 3.7 | 18.0 | 0.0 | QUARTZ VEIN |
| 219 | 93L15 | BGA91-100 | 640706 | 6081950 | 5 | 3.5 | 69.00 | 168.00 | 730.00 | -1 | 2.9 | 6.1 | 40.0 | QUARTZ VEIN |
| 220 | 93L15 | BGA91-101 | 640705 | 6081950 | -2 | -0.4 | 3.00 | 20.00 | 135.00 | 2 | 1.0 | 5.1 | 2.6 | QUARTZ VEIN |
| 221 | 93L15 | BGA91-102 | 640706 | 6081951 | 2 | 1.4 | 7.00 | 38.00 | 43.00 | -1 | 0.3 | 5.7 | 5.0 | QUARTZ VEIN |
| 222 | 93L15 | BGA91-103 | 640718 | 6081944 | 52 | 26.0 | 337.00 | 2500.00 | 26000.00 | 3 | 140.0 | 77.0 | 110.0 | QUARTZ VEIN |
| 223 | 93L15 | BGA91-104 | 639844 | 6086250 | 4 | -0.4 | 24.00 | 5.00 | 133.00 | 3 | 0.3 | 7.8 | 0.4 | QUARTZ VEIN |
| 224 | 93L15 | BGA91-105 | 639843 | 6086250 | 23 | -0.4 | 4.00 | 3.00 | 47.00 | -1 | -0.3 | 310.0 | -0.1 | CHLOR-ANK QUARTZ VEIN |
| 225 | 93L15 | BGA91-106 | 639824 | 6086498 | -2 | -0.4 | 5.00 | 6.00 | 53.00 | -1 | -0.3 | 12.0 | 0.8 | RHYOLITE |
| 226 | 93L15 | BGA91-107 | 639910 | 6086507 | 2 | -0.4 | 15.00 | 9.00 | 134.00 | 0 | 0.6 | 22.0 | 1.3 | RHYOLITE |
| 227 | 93L15 | BGA91-108 | 640061 | 6086515 | 5370 | 12.0 | 213.00 | 54.00 | 68.00 | -6 | 0.3 | 62000.0 | 36.0 | 108-111 RHYOLITE SHOWING |
| 228 | 93L15 | BGA91-108FA | 640061 | 6086515 | 3950 | | | | | | | | | FIRE ASSAY OF BGA91-108 |
| 229 | 93L15 | BGA91-109 | 640055 | 6086518 | 11600 | 7.0 | 555.00 | 33.00 | 138.00 | -6 | 2.0 | 140000.0 | 8.6 | SULPHIDE-QUARTZ VEIN |
| 230 | 93L15 | BGA91-109FA | 640055 | 6086518 | 94900 | | | | | | | | | FIRE ASSAY OF BGA91-109 |
| 231 | 93L15 | BGA91-110 | 640056 | 6086501 | 12800 | 38.0 | 273.00 | 138.00 | 28.00 | -10 | -0.3 | 99000.0 | 30.0 | SULPHIDE-QUARTZ STOCKWORK |
| 232 | 93L15 | BGA91-110FA | 640056 | 6086501 | 13200 | | | | | | | | | FIRE ASSAY OF BGA91-110 |
| 233 | 93L15 | BGA91-111 | 640055 | 6086500 | 12300 | 86.0 | 10900.00 | 50.00 | 1200.00 | -4 | 24.0 | 31000.0 | 98.0 | SULPHIDE VEIN (FLOAT) |
| 234 | 93L15 | BGA91-111FA | 640055 | 6086500 | 10500 | | | | | | | | | FIRE ASSAY OF BGA91-111 |
| 235 | 93L15 | BGA91-112 | 634303 | 6080162 | 12 | -0.4 | 27.00 | 5.00 | 54.00 | -1 | -0.3 | 70.0 | 0.7 | SILTSTONE |
| 236 | 93L15 | BGA91-113 | 633846 | 6080017 | 17 | 0.4 | 1700.00 | 3.00 | 9.00 | 3 | -0.3 | 14.0 | 0.3 | QUARTZ VEIN |
| 237 | 93L15 | BGA91-114 | 638013 | 6084724 | 2 | 0.4 | 7.00 | 15.00 | 32.00 | -5 | -0.3 | 8.4 | 1.1 | RHYOLITE |
| 238 | 93L15 | BGA91-115 | 630242 | 6086717 | -2 | -0.4 | 13.00 | 6.00 | 52.00 | -5 | -0.3 | 7.8 | 1.5 | LIMONITIC SCHIST |
| 239 | 93L15 | BGA91-116 | 632855 | 6086163 | -2 | -0.4 | 67.00 | 16.00 | 30.00 | 4 | -0.3 | 160.0 | 5.0 | SERICITE SCHIST |
| 240 | 93L15 | BGA91-117 | 636042 | 6084726 | 5 | 0.4 | 6.00 | 30.00 | 31.00 | 7 | -0.3 | 49.0 | 2.7 | PYRITIC RHYOLITE |
| 241 | 93L15 | BGA91-118 | 632857 | 6086158 | -2 | -0.4 | 15.00 | 38.00 | 88.00 | -5 | -0.3 | 27.0 | 16.0 | SERICITIC SCHIST |
| 242 | 93L15 | BGA91-119 | 630255 | 6086730 | -2 | -0.4 | 12.00 | 6.00 | 133.00 | -1 | -0.3 | 11.0 | 2.7 | SERICITIC SCHIST |
| 243 | 93L15 | BGA91-120 | 641251 | 6081112 | 7 | -0.4 | 34.00 | 20.00 | 79.00 | -1 | -0.3 | 11.0 | 2.7 | PYRITIC SCHIST |

# APPENDIX E

**Stream-Sediment Geochemical Analyses**

A reconnaissance stream-sediment (and water) geochemical survey was conducted in the Babine Mountains Recreation Area from August 23 to 25, 1991 by J.L. Gravel of Bonaventure Management Services. A total of 39 streams were sampled: methods used to collect and analyze the sediment samples were in accordance with standards set by the RGS program of the Ministry of Energy, Mines and Petroleum Resources (e.g., Matysek *et al.*, 1990) . These data compliment previously released RGS data in 1983 (Hazelton Map Sheet NTS 93M: Geological Survey of Canada Open File 1000) and 1986 (Smithers Map Sheet NTS 93L: Geological Survey of Canada Open File 1361).

Geological formations listed for each sample site (FORM) are the dominant bedrock type within each drainage basin. Statistical manipulation of data utilized the Geological Survey Branch's "Geochemical Applications Software Package".

Samples collected in 1991 were analysed by Chemex Labs Limited, North Vancouver (atomic absorption spectrophotometry) and Actlabs Activation Laboratories Limited, Ancaster, Ontario (neutron activation).

All elements are expressed in parts per million, except gold which is in parts per billion. Analytical methods and detection limits for elements determined are as follows (from Jackaman *et al.*, 1992):

## ANALYTICAL METHODS AND SPECIFICATIONS FOR ROUTINE RGS SUITE OF ELEMENTS

| Element | Detection Limits | Sample Weight | Digestion Technique | Determination Method | |
|---|---|---|---|---|---|
| Cadmium<br>Cobalt<br>Copper<br>Iron<br>Lead<br>Manganese<br>Nickel<br>Silver<br>Zinc | 0.2 ppm<br>2 ppm<br>2 ppm<br>0.02 %<br>2 ppm<br>5 ppm<br>2 ppm<br>0.2 ppm<br>2 ppm | 1 g | 3 mL $HNO_3$ let sit overnight, add 1 mL HCl in 90°C water bath, for 2 hrs. cool, add 2 mL $H_2O$, wait 2 hrs. | AAS | atomic absorption spectrophotometry using air-acetylene burner and standard solutions for calibration, background corrections made for Pb, Ni, Co, Ag, Cd |
| Molybdenum | 1 ppm | 0.5 g | Al added to above solution | | |
| Barium<br>Vanadium<br>Chromium | 10 ppm<br>5 ppm<br>5 ppm | 1 g | $HNO_3$ - HCl - HF taken to dryness, hot HCl added to leach residue | | |
| Bismuth<br>Antimony | 0.2 ppm<br>0.2 ppm | 2 g | HCl - $KClO_2$ digestion, KI added to reduce Fe, MIBK and TOPO for extraction | AAS - H | organic layer analyzed by atomic absorption spectrophotometry with background correction |
| Tin | 1 ppm | 1 g | sintered with $NH_4I$, HCl and ascorbic acid leach | AAS | atomic absorption spectrophotometry |
| Arsenic | 1 ppm | 0.5 g | add 2 mL KI and dilute HCl to 0.8M $HNO_3$ • 0.2M HCl | AAS - H | 2 mL borohydride solution added to produce $AsH_3$ gas which is passed through heated quartz tube in the light path of atomic absorption spectrophotometer |
| Mercury | 10 ppb | 0.5 g | 20 mL $HNO_3$ • 1 mL HCl | AAS - F | 10% stannous sulphate added to evolve mercury vapour, determined by atomic absorption spectrometry |
| Tungsten | 1 ppm | 0.5 g | $K_2SO_4$ fusion, HCl leach | COLOR | colorimetric: reduced tungsten complexed with toluene 3, 4 dithiol |
| Fluorine | 40 ppm | 0.25 g | $NaCO_3$ - $KNO_3$ fusion, $H_2O$ leach | ION | citric acid added and diluted with water, fluorine determined with specific ion electrode |
| Uranium | 0.5 ppm | 1 g | nil | NADNC | neutron activation with delayed neutron counting |
| LOI | 0.1 % | 0.5 g | ash sample at 500°C | GRAV | weight difference |
| pH - water | 0.1 pH unit | 25 mL | nil | GCE | glass - calomel electrode system |
| U - water | 0.05 ppb | 5 mL | add 0.5 mL fluran solution | LIF | place in Scintrex UA-3 |
| F - water | 20 ppb | 25 mL | nil | ION | fluorine ion specific electrode |

## ADDITIONAL ELEMENTS ANALYZED BY INNA

| Element | Detection Limit | Element | Detection Limit |
|---|---|---|---|
| Gold | 2 ppb | Molybdenum | 1 ppm |
| Antimony | 0.1 ppm | Nickel | 10 ppm |
| Arsenic | 0.5 ppm | Rubidium | 5 ppm |
| Barium | 100 ppm | Samarium | 0.5 ppm |
| Bromine | 0.5 ppm | Scandium | 0.5 ppm |
| Cerium | 10 ppm | Sodium | 0.1 % |
| Cesium | 0.5 ppm | Tantalum | 0.5 ppm |
| Chromium | 5 ppm | Terbium | 0.5 ppm |
| Cobalt | 5 ppm | Thorium | 0.5 ppm |
| Hafnium | 1 ppm | Tungsten | 2 ppm |
| Iron | 0.2 % | Uranium | 0.2 ppm |
| Lanthanum | 5 ppm | Ytterbium | 2 ppm |
| Lutetium | 0.2 ppm | Zirconium | 200 ppm |

| MAP | ID | UTME | UTMN | FORM | PH | ZN | CU | PB | NI | CO | AG | MN | MO | CD | V | BI | AU | SB | AS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 93L15 | 861185 | 641126 | 6075322 | mJS | 6.9 | 110 | 50 | 14 | 20 | 13 | 0.2 | 800 | 1 | 0.1 | 40 | -1.0 | 6 | 3.9 | 71.0 |
| 93L15 | 861186 | 642732 | 6077961 | muJA | 6.8 | 117 | 34 | 10 | 48 | 14 | 0.1 | 840 | 1 | 0.1 | 32 | -1.0 | 1 | 2.1 | 18.0 |
| 93L15 | 861187 | 644141 | 6080852 | muJA | 6.9 | 110 | 29 | 13 | 40 | 13 | 0.1 | 600 | 1 | 0.1 | 34 | -1.0 | 14 | 2.4 | 14.0 |
| 93L15 | 861188 | 644141 | 6080852 | muJA | 6.8 | 122 | 32 | 14 | 40 | 13 | 0.1 | 660 | 1 | 0.1 | 32 | -1.0 | 11 | 1.5 | 12.0 |
| 93L15 | 861189 | 645246 | 6081453 | IK | 6.6 | 113 | 25 | 18 | 19 | 10 | 0.1 | 710 | 1 | 0.1 | 34 | -1.0 | 1 | 2.8 | 20.0 |
| 93L15 | 861194 | 648285 | 6085038 | IJ | 6.6 | 89 | 7 | 7 | 16 | 6 | 0.1 | 550 | 1 | 0.1 | 32 | -1.0 | 3 | 0.9 | 12.0 |
| 93L15 | 861195 | 637147 | 6072713 | dr | 6.9 | 121 | 48 | 15 | 18 | 9 | 0.1 | 680 | 5 | 0.1 | 40 | -1.0 | 11 | 2.9 | 50.0 |
| 93L15 | 861244 | 632510 | 6074962 | IJ | 7.1 | 84 | 23 | 6 | 21 | 9 | 0.1 | 590 | 1 | 0.1 | 38 | -1.0 | 1 | 1.6 | 31.0 |
| 93L15 | 861245 | 629750 | 6075930 | IJ | 7.4 | 91 | 23 | 6 | 20 | 13 | 0.3 | 510 | 1 | 0.1 | 47 | -1.0 | 1 | 1.2 | 12.0 |
| 93L15 | 861246 | 631562 | 6079201 | IJ | 7.5 | 137 | 34 | 11 | 19 | 13 | 0.1 | 780 | 1 | 0.2 | 64 | -1.0 | 2 | 2.6 | 13.0 |
| 93L15 | 861255 | 648334 | 6088615 | IJ | 7.3 | 257 | 23 | 92 | 19 | 11 | 0.3 | 640 | 1 | 2.4 | 35 | -1.0 | 20 | 4.8 | 51.0 |
| 93L15 | 861256 | 648334 | 6088615 | IJ | 7.2 | 285 | 27 | 102 | 20 | 12 | 0.8 | 640 | 1 | 2.5 | 34 | -1.0 | 7 | 4.3 | 54.0 |
| 93L15 | 861257 | 647306 | 6093500 | IJ | 7.0 | 108 | 19 | 18 | 20 | 15 | 0.1 | 2000 | 1 | 0.1 | 42 | -1.0 | 2 | 1.5 | 9.0 |
| 93L15 | 861258 | 647019 | 6094951 | IJ | 7.2 | 88 | 18 | 9 | 21 | 13 | 0.1 | 350 | 1 | 0.1 | 42 | -1.0 | 1 | 1.8 | 8.0 |
| 93L15 | 861259 | 647329 | 6090881 | IJ | 7.0 | 78 | 17 | 9 | 13 | 10 | 0.1 | 940 | 1 | 0.1 | 45 | -1.0 | 1 | 1.4 | 9.0 |
| 93L15 | 861260 | 641733 | 6093793 | IJ | 7.1 | 95 | 21 | 14 | 26 | 10 | 0.2 | 510 | 1 | 0.1 | 39 | -1.0 | 2 | 2.3 | 8.0 |
| 93L15 | 861262 | 642035 | 6093444 | IJ | 7.0 | 115 | 27 | 11 | 16 | 11 | 0.2 | 520 | 1 | 0.1 | 42 | -1.0 | 2 | 4.1 | 16.0 |
| 93L15 | 861263 | 643861 | 6087366 | IJ | 6.5 | 204 | 30 | 36 | 18 | 13 | 0.3 | 1100 | 1 | 0.6 | 30 | -1.0 | 30 | 2.2 | 10.0 |
| 93L15 | 861264 | 643515 | 6087847 | IJ | 6.8 | 806 | 49 | 532 | 26 | 14 | 3.0 | 720 | 1 | 9.3 | 26 | -1.0 | 75 | 27.5 | 60.0 |
| 93L15 | 861265 | 640332 | 6087188 | muJA | 6.9 | 235 | 53 | 212 | 34 | 17 | 3.7 | 680 | 1 | 1.4 | 28 | -1.0 | 610 | 18.5 | 40.0 |
| 93L15 | 861266 | 631757 | 6074007 | IJ | 7.4 | 95 | 270 | 9 | 25 | 29 | 0.1 | 6200 | 4 | 0.1 | 33 | -1.0 | 2 | 0.9 | 18.0 |
| 93L15 | 861374 | 634509 | 6084392 | IK | 6.9 | 825 | 42 | 66 | 92 | 31 | 0.7 | 6200 | 1 | 6.7 | 34 | -1.0 | 12 | 3.8 | 30.0 |
| 93L15 | 861375 | 634540 | 6083999 | muJA | 7.0 | 92 | 33 | 15 | 23 | 13 | 0.2 | 580 | 1 | 0.1 | 34 | -1.0 | 1 | 1.8 | 10.0 |
| 93L15 | 861376 | 632497 | 6084718 | uKK | 6.8 | 138 | 36 | 19 | 27 | 16 | 0.4 | 760 | 2 | 0.7 | 22 | -1.0 | 1 | 1.3 | 30.0 |
| 93L15 | 861377 | 630090 | 6083781 | uKK | 6.9 | 266 | 37 | 24 | 38 | 18 | 0.3 | 2200 | 1 | 1.9 | 29 | -1.0 | 1 | 2.2 | 14.0 |
| 93L15 | 861400 | 635284 | 6076780 | mJS | 7.3 | 180 | 38 | 15 | 22 | 11 | 0.5 | 1200 | 1 | 0.8 | 39 | -1.0 | 5 | 2.8 | 57.0 |
| 93L15 | 861424 | 640649 | 6094427 | uKK | 6.9 | 85 | 17 | 13 | 24 | 10 | 0.1 | 260 | 1 | 0.6 | 37 | -1.0 | 1 | 0.9 | 4.0 |
| 93L15 | 861425 | 640272 | 6095874 | uKK | 7.7 | 82 | 20 | 14 | 23 | 12 | 0.1 | 530 | 1 | 0.9 | 43 | -1.0 | 2 | 1.2 | 4.0 |
| 93L15 | 861602 | 634660 | 6076937 | mJS | 7.4 | 119 | 24 | 9 | 23 | 11 | 0.1 | 480 | 1 | 0.1 | 39 | -1.0 | 1 | 1.8 | 33.0 |
| 93L15 | 861782 | 628800 | 6087600 | uKK | 6.9 | 100 | 29 | 11 | 30 | 13 | 0.1 | 700 | 2 | 0.1 | 25 | -1.0 | 1 | 0.5 | 13.0 |
| 93L15 | 861783 | 631787 | 6092167 | uKK | -1.0 | 80 | 23 | 15 | 22 | 11 | 0.1 | 630 | 1 | 0.1 | 34 | -1.0 | 1 | 1.8 | 11.0 |
| 93L15 | 861784 | 631897 | 6091701 | IK | 6.6 | 94 | 26 | 14 | 32 | 14 | 0.1 | 890 | 1 | 0.1 | 35 | -1.0 | 1 | 1.3 | 12.0 |
| 93L15 | 861786 | 628299 | 6089650 | IK | 7.3 | 98 | 34 | 11 | 48 | 14 | 0.1 | 720 | 1 | 0.1 | 33 | -1.0 | 1 | 1.1 | 17.0 |
| 93L14 | 861780 | 627432 | 6094650 | IK | 8.0 | 110 | 29 | 9 | 41 | 12 | 0.1 | 570 | 1 | 0.1 | 35 | -1.0 | 1 | 2.7 | 9.0 |
| 93L14 | 861946 | 621217 | 6093650 | IK | 8.3 | 93 | 40 | 11 | 31 | 14 | 0.1 | 700 | 1 | 0.1 | 43 | -1.0 | 1 | 1.6 | 9.0 |
| 93L14 | 861947 | 621715 | 6093595 | IK | 7.9 | 119 | 49 | 12 | 52 | 17 | 0.1 | 800 | 1 | 0.1 | 40 | -1.0 | 5 | 1.6 | 10.0 |
| 93L14 | 861948 | 621175 | 6089069 | IK | 8.2 | 105 | 42 | 12 | 43 | 14 | 0.1 | 740 | 1 | 0.1 | 42 | -1.0 | 1 | 1.3 | 10.0 |
| 93L14 | 861949 | 623429 | 6088320 | uKK | 7.6 | 94 | 27 | 15 | 34 | 11 | 0.1 | 640 | 1 | 0.1 | 38 | -1.0 | 1 | 3.0 | 29.0 |
| 93L14 | 861951 | 622489 | 6087707 | IK | -1.0 | 95 | 36 | 14 | 22 | 13 | 0.1 | 800 | 1 | 0.1 | 42 | -1.0 | 1 | 2.7 | 17.0 |
| 93L14 | 861954 | 626073 | 6086660 | uKK | 7.6 | 100 | 29 | 20 | 33 | 11 | 0.1 | 740 | 1 | 0.1 | 30 | -1.0 | 1 | 2.5 | 29.0 |
| 93L14 | 861955 | 626073 | 6086660 | uKK | 7.4 | 104 | 30 | 21 | 34 | 12 | 0.1 | 840 | 1 | 0.1 | 33 | -1.0 | 1 | 3.0 | 33.0 |
| 93M02 | 833170 | 637199 | 6102202 | mJS | 6.9 | 109 | 17 | 4 | 32 | 15 | 0.2 | 679 | 1 | -1.0 | -1 | -1.0 | 2 | 3.0 | 25.0 |
| 93M02 | 833173 | 632803 | 6103051 | uKK | 7.4 | 90 | 26 | 5 | 34 | 16 | 0.1 | 855 | 1 | -1.0 | -1 | -1.0 | 3 | 4.1 | 20.0 |

| MAP | ID | UTME | UTMN | FORM | PH | ZN | CU | PB | NI | CO | AG | MN | MO | CD | V | BI | AU | SB | AS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 93M02 | 833174 | 631079 | 6102826 | uKK | 7.5 | 83 | 28 | 6 | 22 | 15 | 0.1 | 763 | 1 | -1.0 | -1 | -1.0 | 3 | 6.4 | 23.0 |
| 93M02 | 833175 | 631201 | 6102501 | uKK | 7.6 | 116 | 50 | 8 | 60 | 20 | 0.1 | 833 | 1 | -1.0 | -1 | -1.0 | 5 | 5.5 | 40.0 |
| 93M02 | 833176 | 628900 | 6102600 | uKK | 7.8 | 66 | 24 | 6 | 15 | 16 | 0.1 | 838 | 1 | -1.0 | -1 | -1.0 | 3 | 7.4 | 18.0 |
| 93M02 | 833177 | 628200 | 6101000 | lJ | 7.7 | 106 | 44 | 5 | 39 | 20 | 0.1 | 878 | 1 | -1.0 | -1 | -1.0 | 2 | 4.7 | 23.0 |
| 93M03 | 833178 | 626900 | 6098200 | lJ | 7.5 | 86 | 36 | 6 | 28 | 17 | 0.1 | 866 | 1 | -1.0 | -1 | -1.0 | 5 | 2.2 | 13.0 |
| 93M02 | 833179 | 635906 | 6098342 | uKK | 7.5 | 68 | 27 | 5 | 27 | 15 | 0.1 | 827 | 1 | -1.0 | -1 | -1.0 | 2 | 6.3 | 16.0 |
| 93M02 | 833180 | 641102 | 6097244 | uKK | 7.6 | 80 | 19 | 8 | 26 | 13 | 0.1 | 720 | 1 | -1.0 | -1 | -1.0 | 2 | 4.3 | 14.0 |
| 93L15 | 911002 | 641870 | 6085147 | lJ | 7.6 | 144 | 40 | 20 | 21 | 16 | 0.2 | 1450 | 1 | 0.2 | 31 | 0.2 | 27 | 4.0 | 89.0 |
| 93L15 | 911003 | 641548 | 6085237 | muJA | 7.5 | 372 | 43 | 105 | 42 | 15 | 1.7 | 1150 | 1 | 2.4 | 34 | 0.1 | 12 | 7.0 | 36.0 |
| 93L15 | 911004 | 642963 | 6086179 | lJ | 7.6 | 165 | 18 | 12 | 5 | 9 | 0.1 | 1700 | 1 | 0.1 | 19 | 0.1 | 2 | 5.0 | 8.0 |
| 93L15 | 911005 | 646145 | 6085616 | lJ | 8.0 | 140 | 37 | 19 | 16 | 9 | 1.5 | 1000 | 4 | 0.5 | 49 | 0.4 | 8 | 7.0 | 70.0 |
| 93L15 | 911007 | 646025 | 6086288 | lJ | 7.5 | 160 | 27 | 17 | 13 | 9 | 0.2 | 910 | 1 | 0.6 | 54 | 0.3 | 2 | 6.0 | 54.0 |
| 93L15 | 911008 | 646025 | 6086288 | lJ | 8.1 | 160 | 29 | 15 | 13 | 9 | 0.1 | 920 | 1 | 0.6 | 52 | 0.3 | 2 | 5.0 | 54.0 |
| 93L15 | 911009 | 645354 | 6081385 | lJ | 7.7 | 106 | 23 | 10 | 21 | 11 | 0.1 | 920 | 1 | 0.1 | 51 | 0.1 | 2 | 4.0 | 27.0 |
| 93L15 | 911010 | 645223 | 6082647 | lJ | 7.4 | 124 | 22 | 18 | 16 | 11 | 0.1 | 1150 | 1 | 0.2 | 50 | 0.1 | 3 | 5.0 | 44.0 |
| 93L15 | 911011 | 645383 | 6082810 | lJ | 7.4 | 128 | 23 | 13 | 16 | 11 | 0.1 | 1100 | 1 | 0.3 | 47 | 0.2 | 2 | 5.0 | 32.0 |
| 93L15 | 911012 | 637833 | 6073840 | dr | 8.0 | 125 | 53 | 16 | 17 | 14 | 0.1 | 1200 | 6 | 0.2 | 55 | 0.3 | 2 | 7.0 | 50.0 |
| 93L15 | 911013 | 637804 | 6075042 | mJS | 8.0 | 140 | 60 | 13 | 12 | 11 | 0.1 | 1200 | 3 | 0.2 | 40 | 0.5 | 4 | 9.0 | 240.0 |
| 93L15 | 911014 | 638798 | 6076928 | mJS | 8.1 | 148 | 40 | 17 | 22 | 13 | 0.1 | 1600 | 1 | 0.1 | 38 | 0.1 | 10 | 8.0 | 140.0 |
| 93L15 | 911015 | 632562 | 6084592 | lK | -1.0 | 212 | 49 | 25 | 37 | 32 | 0.1 | 1200 | 1 | 0.4 | 19 | 0.4 | 5 | 6.0 | 43.0 |
| 93L15 | 911016 | 630844 | 6084560 | lK | 8.3 | 94 | 17 | 15 | 19 | 13 | 0.1 | 880 | 1 | 0.1 | 22 | 0.1 | 4 | 5.0 | 43.0 |
| 93L15 | 911017 | 630515 | 6081884 | lJ | 8.4 | 140 | 43 | 30 | 17 | 14 | 0.1 | 870 | 1 | 0.4 | 63 | 0.1 | 2 | 8.0 | 56.0 |
| 93L15 | 911018 | 630401 | 6081083 | lJ | 8.5 | 140 | 48 | 10 | 17 | 17 | 0.1 | 885 | 1 | 0.1 | 55 | 0.1 | 2 | 5.0 | 20.0 |
| 93L15 | 911019 | 636475 | 6080757 | muJA | 7.6 | 110 | 33 | 5 | 26 | 13 | 0.1 | 1200 | 1 | 0.1 | 32 | 0.1 | 2 | 4.0 | 39.0 |
| 93L15 | 911020 | 639993 | 6078627 | muJA | 7.7 | 125 | 27 | 6 | 43 | 15 | 0.1 | 1400 | 1 | 0.1 | 30 | 0.1 | 2 | 3.0 | 32.0 |
| 93L15 | 911022 | 642185 | 6081831 | muJA | 7.5 | 202 | 55 | 11 | 95 | 35 | 0.1 | 1550 | 1 | 0.1 | 28 | 0.1 | 2 | 10.0 | 16.0 |
| 93L15 | 911023 | 642030 | 6082074 | uKK | 7.4 | 175 | 43 | 16 | 55 | 22 | 0.1 | 1600 | 1 | 0.3 | 23 | 0.2 | 2 | 4.0 | 18.0 |
| 93L15 | 911024 | 639538 | 6086721 | uKK | 7.6 | 290 | 55 | 190 | 32 | 15 | 12.0 | 970 | 1 | 1.7 | 28 | 0.1 | 3 | 3.0 | 18.0 |
| 93L15 | 911025 | 639694 | 6086622 | muJA | 7.6 | 174 | 58 | 13 | 85 | 23 | 0.1 | 1900 | 1 | 0.5 | 33 | 0.1 | 184 | 16.0 | 35.0 |
| 93L15 | 911026 | 640695 | 6090607 | muJA | 7.5 | 97 | 25 | 13 | 23 | 14 | 0.1 | 880 | 1 | 0.1 | 50 | 0.1 | 2 | 4.0 | 22.0 |
| 93L15 | 911027 | 638173 | 6091216 | uKK | 7.6 | 102 | 30 | 31 | 28 | 14 | 0.1 | 760 | 1 | 0.1 | 52 | 0.1 | 2 | 3.0 | 15.0 |
| 93L15 | 911028 | 638102 | 6091387 | uKK | 7.5 | 112 | 33 | 27 | 30 | 14 | 0.1 | 845 | 1 | 0.1 | 53 | 0.1 | 4 | 3.0 | 15.0 |
| 93L15 | 911029 | 637677 | 6093322 | uKK | 7.6 | 118 | 30 | 16 | 26 | 14 | 0.1 | 1150 | 1 | 0.1 | 38 | 0.1 | 2 | 5.0 | 17.0 |
| 93L15 | 911030 | 637677 | 6093322 | uKK | 7.5 | 128 | 31 | 23 | 30 | 15 | 0.1 | 1300 | 1 | 0.1 | 43 | 0.1 | 2 | 5.0 | 18.0 |
| 93L15 | 911031 | 636114 | 6095014 | uKK | 7.9 | 120 | 40 | 38 | 25 | 17 | 0.1 | 900 | 1 | 0.4 | 45 | 0.8 | 2 | 5.0 | 15.0 |
| 93L15 | 911032 | 635057 | 6096513 | uKK | 8.0 | 56 | 25 | 11 | 19 | 13 | 0.1 | 580 | 1 | 0.1 | 28 | 0.1 | 3 | 4.0 | 10.0 |
| 93M02 | 911033 | 632234 | 6100022 | uKK | 7.4 | 87 | 22 | 6 | 23 | 12 | 0.1 | 1500 | 1 | 0.1 | 57 | 0.1 | 2 | 3.0 | 17.0 |
| 93M02 | 911034 | 632454 | 6099200 | uKK | 7.5 | 80 | 22 | 7 | 22 | 12 | 0.1 | 710 | 1 | 0.1 | 67 | 0.1 | 2 | 4.0 | 13.0 |
| 93L15 | 911035 | 630017 | 6096125 | uKK | 7.8 | 85 | 21 | 10 | 19 | 14 | 0.1 | 1200 | 1 | 0.1 | 38 | 0.1 | 6 | 4.0 | 16.0 |
| 93L15 | 911037 | 629618 | 6096070 | lJ | 6.1 | 100 | 28 | 9 | 22 | 13 | 0.1 | 870 | 1 | 0.1 | 39 | 0.1 | 2 | 4.0 | 23.0 |
| 93M03 | 911038 | 627468 | 6096935 | lJ | 8.0 | 75 | 22 | 8 | 22 | 13 | 0.1 | 740 | 1 | 0.1 | 40 | 0.1 | 2 | 4.0 | 18.0 |
| 93M03 | 911039 | 628654 | 6098778 | uKK | 8.0 | 87 | 33 | 5 | 32 | 19 | 0.1 | 870 | 1 | 0.1 | 45 | 0.1 | 2 | 3.0 | 44.0 |
| 93L15 | 911040 | 632251 | 6091935 | uKK | 7.8 | 106 | 28 | 10 | 33 | 16 | 0.1 | 1000 | 1 | 0.1 | 36 | 0.1 | 2 | 2.0 | 17.0 |

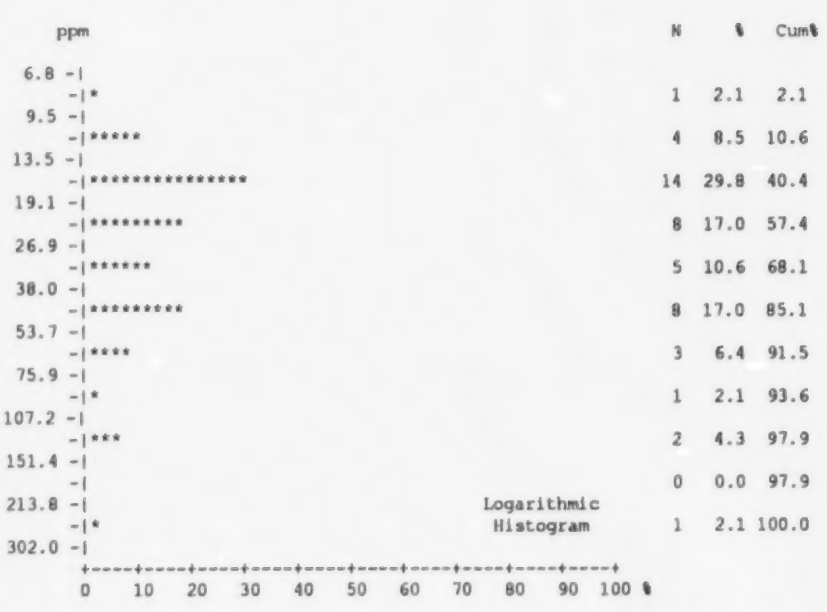
| MAP | ID | UTME | UTMN | FORM | PH | ZN | CU | PB | NI | CO | AG | MN | MO | CD | V | BI | AU | SB | AS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 93L15 | 911042 | 628581 | 6089687 | IK | 8.1 | 104 | 40 | 8 | 25 | 16 | 0.1 | 610 | 1 | 0.1 | 20 | 0.2 | 11 | 9.0 | 120.0 |
| 93L14 | 911043 | 627381 | 6088113 | IK | 7.8 | 115 | 40 | 9 | 42 | 14 | 0.1 | 1200 | 1 | 0.1 | 37 | 0.1 | 2 | 4.0 | 40.0 |
| 93L15 | 911044 | 629961 | 6088072 | uKK | 7.6 | 145 | 50 | 30 | 20 | 14 | 0.1 | 1700 | 1 | 0.3 | 32 | 0.2 | 2 | 3.0 | 24.0 |
| 93L14 | 911045 | 622329 | 6089102 | IK | 8.0 | 95 | 27 | 11 | 41 | 12 | 0.1 | 630 | 1 | 0.1 | 45 | 0.1 | 2 | 2.0 | 10.0 |

## Stream-Sediment Geochemical Analyses:

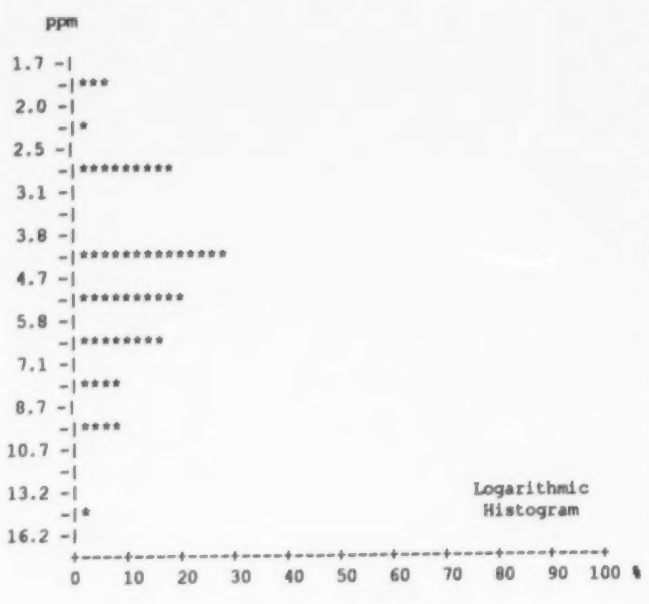
### Statistical Summary of Data by Element and Geological Formation:

# Arsenic (ppm)

| | All | uKK | lJ |
|---|---|---|---|
| N | 47 | 19 | 13 |
| N > DL | 47 | 19 | 13 |
| Missing | 0 | 0 | 0 |
| Mean | 36.98 | 19.47 | 36.69 |
| Median | 23.00 | 17.00 | 27.00 |
| Mode | 18.00 | 15.00 | 23.00 |
| Range | 232.0 | 34.0 | 81.0 |
| St Dev | 40.32 | 8.59 | 24.28 |
| Coef Var | 1.090 | 0.441 | 0.662 |
| Log Mean | 1.434 | 1.260 | 1.473 |
| Geo Mean | 27.18 | 18.20 | 29.73 |
| Log StDv | 0.310 | 0.153 | 0.302 |
| Log CVar | 0.216 | 0.122 | 0.205 |
| Percntls | | | |
| Minimum | 8.0 | 10.0 | 8.0 |
| 10th | 13.0 | 13.0 | 8.0 |
| 20th | 15.0 | 15.0 | 18.0 |
| 30th | 17.0 | 15.0 | 20.0 |
| 40th | 18.0 | 16.0 | 23.0 |
| 50th | 23.0 | 17.0 | 27.0 |
| 60th | 27.0 | 17.0 | 32.0 |
| 70th | 39.0 | 18.0 | 44.0 |
| 80th | 44.0 | 20.0 | 54.0 |
| 85th | 50.0 | 23.0 | 56.0 |
| 90th | 56.0 | 24.0 | 70.0 |
| 95th | 120.0 | 40.0 | 70.0 |
| 98th | 140.0 | 44.0 | 89.0 |
| 99th | 240.0 | 44.0 | 89.0 |
| Maximum | 240.0 | 44.0 | 89.0 |




| Element Statistics |
|---|
| Variable - Arsenic (As) |
| Number of Values - 47 |
| Units - ppm |
| Detection Limit - 0.5 |
| Analytical Method - INAA |

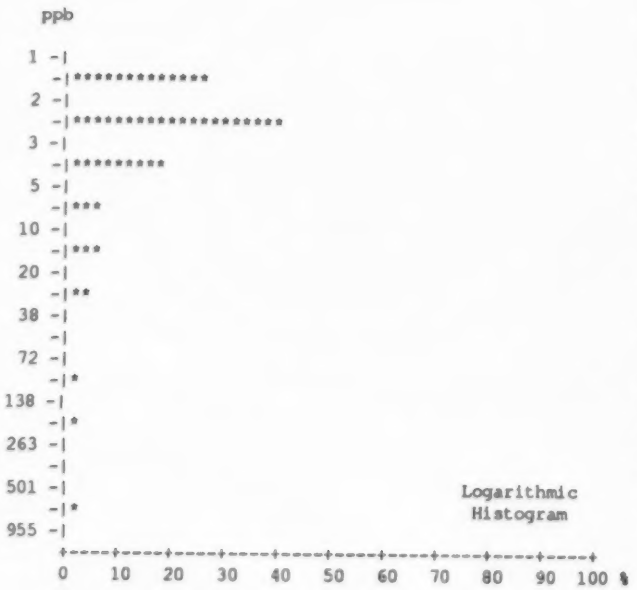



| | N | % | Cum% |
|---|---|---|---|
| 1.7 - 2.0 | 2 | 4.3 | 4.3 |
| 2.0 - 2.5 | 1 | 2.1 | 6.4 |
| 2.5 - 3.1 | 8 | 17.0 | 23.4 |
| 3.1 - 3.8 | 0 | 0.0 | 23.4 |
| 3.8 - 4.7 | 13 | 27.7 | 51.1 |
| 4.7 - 5.8 | 9 | 19.1 | 70.2 |
| 5.8 - 7.1 | 7 | 14.9 | 85.1 |
| 7.1 - 8.7 | 3 | 6.4 | 91.5 |
| 8.7 - 10.7 | 3 | 6.4 | 97.9 |
| 10.7 - 13.2 | 0 | 0.0 | 97.9 |
| 13.2 - 16.2 | 1 | 2.1 | 100.0 |

| | All | uKK | IJ |
|---|---|---|---|
| N | 47 | 19 | 13 |
| N > DL | 47 | 19 | 13 |
| Missing | 0 | 0 | 0 |
| Mean | 5.13 | 4.21 | 4.92 |
| Median | 4.30 | 4.00 | 5.00 |
| Mode | 4.00 | 3.00 | 4.00 |
| Range | 14.0 | 5.4 | 5.8 |
| St Dev | 2.51 | 1.42 | 1.47 |
| Coef Var | 0.489 | 0.336 | 0.299 |
| Log Mean | 0.669 | 0.602 | 0.673 |
| Geo Mean | 4.66 | 4.00 | 4.71 |
| Log StDv | 0.186 | 0.144 | 0.137 |
| Log CVar | 0.279 | 0.240 | 0.204 |
| Percntls | | | |
| Minimum | 2.0 | 2.0 | 2.2 |
| 10th | 3.0 | 3.0 | 2.2 |
| 20th | 3.0 | 3.0 | 4.0 |
| 30th | 4.0 | 3.0 | 4.0 |
| 40th | 4.0 | 4.0 | 4.0 |
| 50th | 4.3 | 4.0 | 5.0 |
| 60th | 5.0 | 4.0 | 5.0 |
| 70th | 5.5 | 4.3 | 5.0 |
| 80th | 7.0 | 5.0 | 5.0 |
| 85th | 7.0 | 5.5 | 6.0 |
| 90th | 8.0 | 6.3 | 7.0 |
| 95th | 9.0 | 6.4 | 7.0 |
| 98th | 10.0 | 7.4 | 8.0 |
| 99th | 16.0 | 7.4 | 8.0 |
| Maximum | 16.0 | 7.4 | 8.0 |

| Element Statistics |
|---|
| Variable - Antimony [Sb] |
| Number of Values - 47 |
| Units - ppm |
| Detection Limit - 0.1 |
| Analytical Method - INAA |

# Antimony (ppm)




| | N | % | Cum% |
|---|---|---|---|
| | 21 | 24.7 | 24.7 |
| | 34 | 40.0 | 64.7 |
| | 15 | 17.6 | 82.4 |
| | 4 | 4.7 | 87.1 |
| | 5 | 5.9 | 92.9 |
| | 3 | 3.5 | 96.5 |
| | 0 | 0.0 | 96.5 |
| | 1 | 1.2 | 97.6 |
| | 1 | 1.2 | 98.8 |
| | 0 | 0.0 | 98.8 |
| | 1 | 1.2 | 100.0 |

| Element Statistics |
|---|
| Variable - Gold [Au] |
| Number of Values - 85 |
| Units - ppb |
| Detection Limit - 1 |
| Analytical Method - FA-NA |

| | All | uKK | lJ | lK | muJA |
|---|---|---|---|---|---|
| N | 85 | 27 | 26 | 14 | 10 |
| N > DL | 64 | 20 | 22 | 7 | 8 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | 13.9 | 2.3 | 7.8 | 3.4 | 83.0 |
| Median | 2.0 | 2.0 | 2.0 | 1.0 | 2.0 |
| Mode | 2.0 | 2.0 | 2.0 | 1.0 | 2.0 |
| Range | 609 | 5 | 74 | 11 | 609 |
| St Dev | 68.88 | 1.23 | 15.79 | 3.74 | 193.63 |
| Coef Var | 4.949 | 0.543 | 2.023 | 1.090 | 2.333 |
| Log Mean | 0.457 | 0.299 | 0.494 | 0.337 | 0.848 |
| Geo Mean | 2.9 | 2.0 | 3.1 | 2.2 | 7.0 |
| Log StDv | 0.507 | 0.221 | 0.494 | 0.409 | 0.974 |
| Log CVar | 1.110 | 0.738 | 1.001 | 1.214 | 1.150 |
| Percntls | | | | | |
| Minimum | 1 | 1 | 1 | 1 | 1 |
| 10th | 1 | 1 | 1 | 1 | 1 |
| 20th | 1 | 1 | 2 | 1 | 1 |
| 30th | 2 | 2 | 2 | 1 | 2 |
| 40th | 2 | 2 | 2 | 1 | 2 |
| 50th | 2 | 2 | 2 | 1 | 2 |
| 60th | 2 | 2 | 2 | 2 | 2 |
| 70th | 3 | 2 | 2 | 4 | 12 |
| 80th | 5 | 3 | 5 | 5 | 14 |
| 85th | 6 | 3 | 8 | 5 | 184 |
| 90th | 12 | 3 | 20 | 11 | 184 |
| 95th | 27 | 5 | 30 | 11 | 610 |
| 98th | 75 | 5 | 30 | 12 | 610 |
| 99th | 184 | 6 | 75 | 12 | 610 |
| Maximum | 610 | 6 | 75 | 12 | 610 |

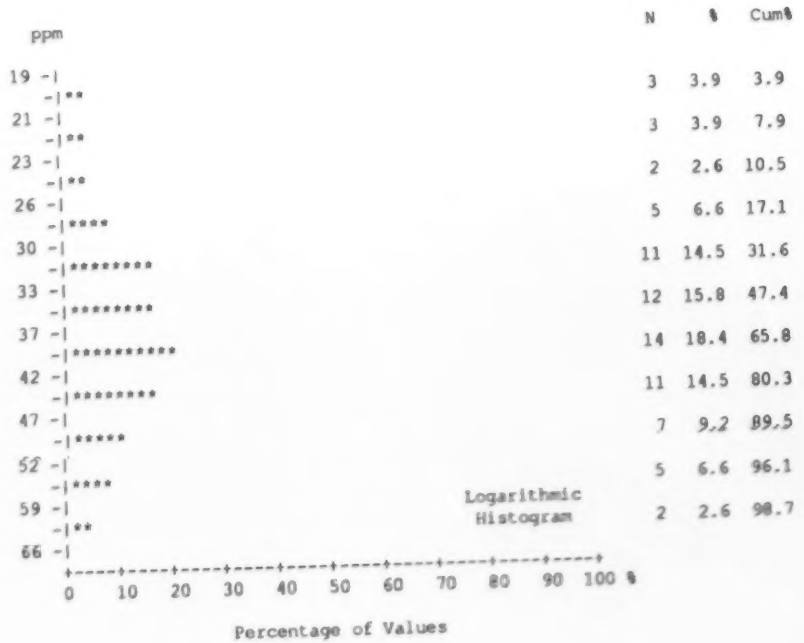
# Gold (ppb)

Histograms are not calculated for variables with fewer than 15 samples above the detection limit.

| Element Statistics |
|---|
| Variable - Bismuth [Bi] |
| Number of Values - 38 |
| Units - ppm |
| Detection Limit - 0.2 |
| Analytical Method - AAS |

| | All | uKK | 1J |
|---|---|---|---|
| N | 38 | 13 | 11 |
| N > DL | 6 | 1 | 2 |
| Missing | 47 | 14 | 15 |
| Mean | 0.17 | 0.17 | 0.16 |
| Median | 0.10 | 0.10 | 0.10 |
| Mode | 0.10 | 0.10 | 0.10 |
| Range | 0.7 | 0.7 | 0.3 |
| St Dev | 0.15 | 0.19 | 0.10 |
| Coef Var | 0.863 | 1.141 | 0.628 |
| Log Mean | -0.861 | -0.884 | -0.847 |
| Geo Mean | 0.14 | 0.13 | 0.14 |
| Log StDv | 0.244 | 0.262 | 0.227 |
| Log CVar | -0.284 | -0.296 | -0.268 |
| Percntls | | | |
| Minimum | 0.1 | 0.1 | 0.1 |
| 10th | 0.1 | 0.1 | 0.1 |
| 20th | 0.1 | 0.1 | 0.1 |
| 30th | 0.1 | 0.1 | 0.1 |
| 40th | 0.1 | 0.1 | 0.1 |
| 50th | 0.1 | 0.1 | 0.1 |
| 60th | 0.1 | 0.1 | 0.1 |
| 70th | 0.1 | 0.1 | 0.2 |
| 80th | 0.2 | 0.1 | 0.2 |
| 85th | 0.2 | 0.2 | 0.2 |
| 90th | 0.3 | 0.2 | 0.3 |
| 95th | 0.4 | 0.2 | 0.3 |
| 98th | 0.5 | 0.8 | 0.4 |
| 99th | 0.8 | 0.8 | 0.4 |
| Maximum | 0.8 | 0.8 | 0.4 |

# Bismuth (ppm)

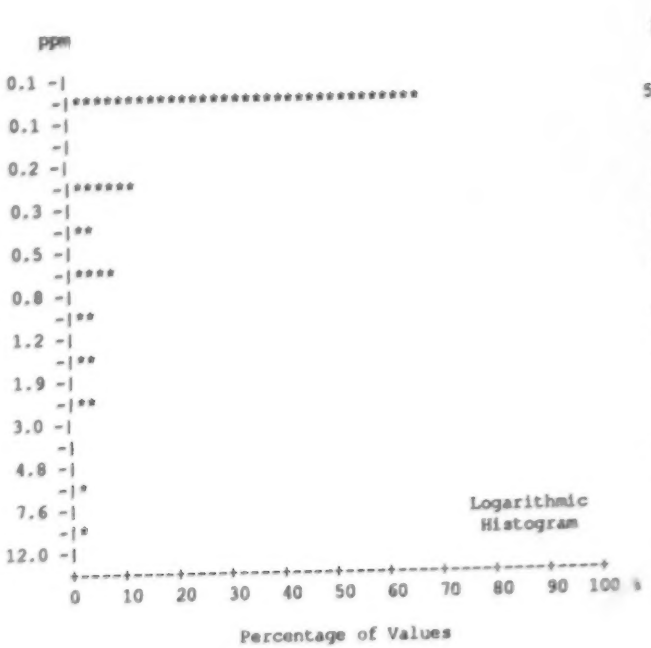



| ppm | N | % | Cum% |
|---|---|---|---|
| 19 | 3 | 3.9 | 3.9 |
| 21 | 3 | 3.9 | 7.9 |
| 23 | 2 | 2.6 | 10.5 |
| 26 | 5 | 6.6 | 17.1 |
| 30 | 11 | 14.5 | 31.6 |
| 33 | 12 | 15.8 | 47.4 |
| 37 | 14 | 18.4 | 65.8 |
| 42 | 11 | 14.5 | 80.3 |
| 47 | 7 | 9.2 | 89.5 |
| 52 | 5 | 6.6 | 96.1 |
| 59 | 2 | 2.6 | 98.7 |
| 66 | | | |

| Element Statistics |
|---|
| Variable - Vanadium [V] |
| Number of Values - 76 |
| Units - ppm |
| Detection Limit - 5 |
| Analytical Method - AAS |

| | All | 1J | uKK | 1K | muJA |
|---|---|---|---|---|---|
| N | 76 | 24 | 21 | 14 | 10 |
| N > DL | 76 | 24 | 21 | 14 | 10 |
| Missing | 9 | 2 | 6 | 0 | 0 |
| Mean | 38.4 | 42.2 | 38.1 | 34.4 | 33.5 |
| Median | 38.0 | 42.0 | 37.0 | 35.0 | 32.0 |
| Mode | 34.0 | 42.0 | 38.0 | 34.0 | 34.0 |
| Range | 48 | 45 | 45 | 26 | 22 |
| St Dev | 10.33 | 11.05 | 11.83 | 8.51 | 6.24 |
| Coef Var | 0.269 | 0.262 | 0.310 | 0.248 | 0.186 |
| Log Mean | 1.569 | 1.610 | 1.562 | 1.521 | 1.519 |
| Geo Mean | 37.1 | 40.7 | 36.5 | 33.2 | 33.1 |
| Log StDv | 0.119 | 0.123 | 0.131 | 0.124 | 0.071 |
| Log CVar | 0.076 | 0.076 | 0.084 | 0.082 | 0.047 |
| Percntls | | | | | |
| Minimum | 19 | 19 | 22 | 19 | 28 |
| 10th | 26 | 26 | 23 | 19 | 28 |
| 20th | 30 | 32 | 28 | 22 | 28 |
| 30th | 33 | 35 | 29 | 33 | 30 |
| 40th | 34 | 39 | 32 | 34 | 32 |
| 50th | 38 | 42 | 37 | 35 | 32 |
| 60th | 40 | 42 | 38 | 35 | 33 |
| 70th | 42 | 47 | 43 | 40 | 34 |
| 80th | 45 | 50 | 45 | 42 | 34 |
| 85th | 50 | 51 | 52 | 42 | 34 |
| 90th | 52 | 55 | 53 | 43 | 34 |
| 95th | 55 | 63 | 57 | 43 | 50 |
| 98th | 63 | 64 | 67 | 45 | 50 |
| 99th | 64 | 64 | 67 | 45 | 50 |
| Maximum | 67 | 64 | 67 | 45 | 50 |

# Vanadium (ppm)




| | N | % | Cum% |
|---|---|---|---|
| | 50 | 65.8 | 65.8 |
| | 0 | 0.0 | 65.8 |
| | 8 | 10.5 | 76.3 |
| | 3 | 3.9 | 80.3 |
| | 6 | 7.9 | 88.2 |
| | 2 | 2.6 | 90.8 |
| | 3 | 3.9 | 94.7 |
| | 2 | 2.6 | 97.4 |
| | 0 | 0.0 | 97.4 |
| | 1 | 1.3 | 98.7 |
| | 1 | 1.3 | 100.0 |

| Element Statistics |
|---|
| Variable - Cadmium [Cd] |
| Number of Values - 76 |
| Units - ppm |
| Detection Limit - 0.2 |
| Analytical Method - AAS |

| | All | 1J | uKK | 1K | muJA |
|---|---|---|---|---|---|
| N | 76 | 24 | 21 | 14 | 10 |
| N > DL | 21 | 7 | 8 | 2 | 3 |
| Missing | 9 | 2 | 6 | 0 | 0 |
| Mean | 0.51 | 0.67 | 0.39 | 0.59 | 0.50 |
| Median | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Mode | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Range | 9.2 | 9.2 | 1.8 | 6.6 | 2.3 |
| St Dev | 1.35 | 1.90 | 0.52 | 1.76 | 0.78 |
| Coef Var | 2.619 | 2.831 | 1.360 | 2.968 | 1.569 |
| Log Mean | -0.719 | -0.684 | -0.684 | -0.827 | -0.677 |
| Geo Mean | 0.19 | 0.21 | 0.21 | 0.15 | 0.21 |
| Log StDv | 0.475 | 0.508 | 0.453 | 0.502 | 0.544 |
| Log CVar | -0.662 | -0.744 | -0.663 | -0.608 | -0.804 |
| Percntls | | | | | |
| Minimum | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 10th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 20th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 30th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 40th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 50th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 60th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 70th | 0.2 | 0.2 | 0.3 | 0.1 | 0.1 |
| 80th | 0.4 | 0.4 | 0.6 | 0.1 | 0.5 |
| 85th | 0.6 | 0.5 | 0.7 | 0.1 | 1.4 |
| 90th | 0.8 | 0.6 | 0.9 | 0.4 | 1.4 |
| 95th | 1.9 | 2.4 | 1.7 | 0.4 | 2.4 |
| 98th | 2.4 | 9.3 | 1.9 | 6.7 | 2.4 |
| 99th | 6.7 | 9.3 | 1.9 | 6.7 | 2.4 |
| Maximum | 9.3 | 9.3 | 1.9 | 6.7 | 2.4 |

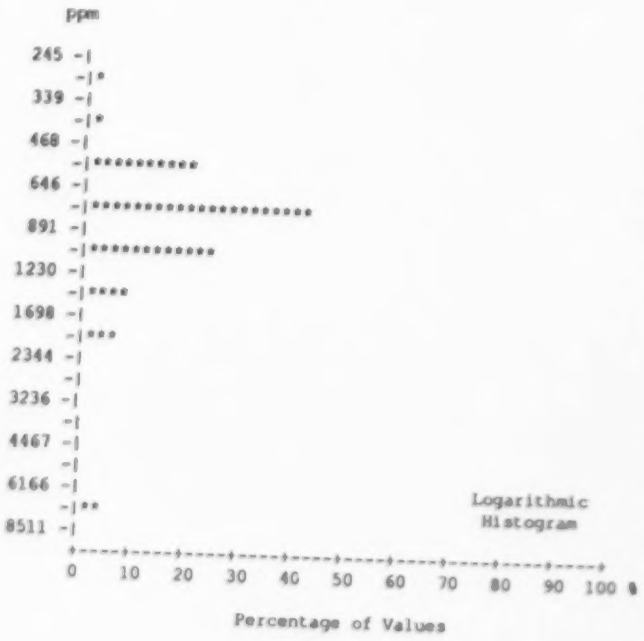
# Cadmium (ppm)

# Molybdenum (ppm)

| | All | uKK | 1J | 1K | muJA |
|---|---|---|---|---|---|
| N | 85 | 27 | 26 | 14 | 10 |
| N > DL | 7 | 2 | 2 | 0 | 0 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | 1.2 | 1.1 | 1.2 | 1.0 | 1.0 |
| Median | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Mode | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Range | 5 | 1 | 3 | 0 | 0 |
| St Dev | 0.85 | 0.27 | 0.82 | 0.00 | 0.00 |
| Coef Var | 0.695 | 0.248 | 0.662 | 0.000 | 0.000 |
| Log Mean | 0.044 | 0.022 | 0.046 | 0.000 | 0.000 |
| Geo Mean | 1.1 | 1.1 | 1.1 | 1.0 | 1.0 |
| Log StDv | 0.157 | 0.080 | 0.164 | 0.000 | 0.000 |
| Log CVar | 3.560 | 3.652 | 3.557 | 0.000 | 0.000 |
| Percntls | | | | | |
| Minimum | 1 | 1 | 1 | 1 | 1 |
| 10th | 1 | 1 | 1 | 1 | 1 |
| 20th | 1 | 1 | 1 | 1 | 1 |
| 30th | 1 | 1 | 1 | 1 | 1 |
| 40th | 1 | 1 | 1 | 1 | 1 |
| 50th | 1 | 1 | 1 | 1 | 1 |
| 60th | 1 | 1 | 1 | 1 | 1 |
| 70th | 1 | 1 | 1 | 1 | 1 |
| 80th | 1 | 1 | 1 | 1 | 1 |
| 85th | 1 | 1 | 1 | 1 | 1 |
| 90th | 1 | 1 | 1 | 1 | 1 |
| 95th | 3 | 2 | 4 | 1 | 1 |
| 98th | 4 | 2 | 4 | 1 | 1 |
| 99th | 5 | 2 | 4 | 1 | 1 |
| Maximum | 6 | 2 | 4 | 1 | 1 |

| Element Statistics |
|---|
| Variable - Molybdenum [Mo] |
| Number of Values - 85 |
| Units - ppm |
| Detection Limit - 1 |
| Analytical Method - AAS |

Histograms are not calculated for variables with fewer than 15 samples above the detection limit.




| | N | % | Cum% |
|---|---|---|---|
| | 1 | 1.2 | 1.2 |
| | 1 | 1.2 | 2.4 |
| | 16 | 18.8 | 21.2 |
| | 35 | 41.2 | 62.4 |
| | 19 | 22.4 | 84.7 |
| | 6 | 7.1 | 91.8 |
| | 5 | 5.9 | 97.6 |
| | 0 | 0.0 | 97.6 |
| | 0 | 0.0 | 97.6 |
| | 0 | 0.0 | 97.6 |
| | 2 | 2.4 | 100.0 |

| Element Statistics |
|---|
| Variable - Manganese [Mn] |
| Number of Values - 85 |
| Units - ppm |
| Detection Limit - 5 |
| Analytical Method - AAS |

| | All | uKK | LJ | LK | muJA |
|---|---|---|---|---|---|
| N | 85 | 27 | 26 | 14 | 10 |
| N > DL | 85 | 27 | 26 | 14 | 10 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | 1046.8 | 928.2 | 1105.7 | 1189.3 | 1068.0 |
| Median | 845.0 | 833.0 | 870.0 | 740.0 | 880.0 |
| Mode | 1200.0 | 760.0 | 510.0 | 800.0 | 580.0 |
| Range | 5940 | 1940 | 5850 | 5630 | 1220 |
| St Dev | 884.08 | 408.57 | 1102.91 | 1454.94 | 421.32 |
| Coef Var | 0.845 | 0.440 | 0.997 | 1.223 | 0.394 |
| Log Mean | 2.954 | 2.932 | 2.955 | 2.958 | 2.997 |
| Geo Mean | 899.2 | 854.3 | 902.6 | 908.2 | 994.1 |
| Log StDv | 0.209 | 0.180 | 0.240 | 0.259 | 0.175 |
| Log CVar | 0.071 | 0.062 | 0.081 | 0.087 | 0.058 |
| Percntls | | | | | |
| Minimum | 260 | 260 | 350 | 570 | 580 |
| 10th | 560 | 560 | 510 | 570 | 580 |
| 20th | 640 | 640 | 550 | 630 | 600 |
| 30th | 720 | 720 | 720 | 700 | 680 |
| 40th | 763 | 760 | 780 | 720 | 840 |
| 50th | 845 | 833 | 870 | 740 | 880 |
| 60th | 880 | 845 | 910 | 800 | 1150 |
| 70th | 1000 | 900 | 940 | 880 | 1200 |
| 80th | 1200 | 1150 | 1100 | 890 | 1400 |
| 85th | 1200 | 1200 | 1150 | 1200 | 1550 |
| 90th | 1600 | 1500 | 1450 | 1200 | 1550 |
| 95th | 1800 | 1700 | 2000 | 1200 | 1800 |
| 98th | 2200 | 1700 | 2000 | 6200 | 1800 |
| 99th | 6200 | 2200 | 6200 | 6200 | 1800 |
| Maximum | 6200 | 2200 | 6200 | 6200 | 1800 |

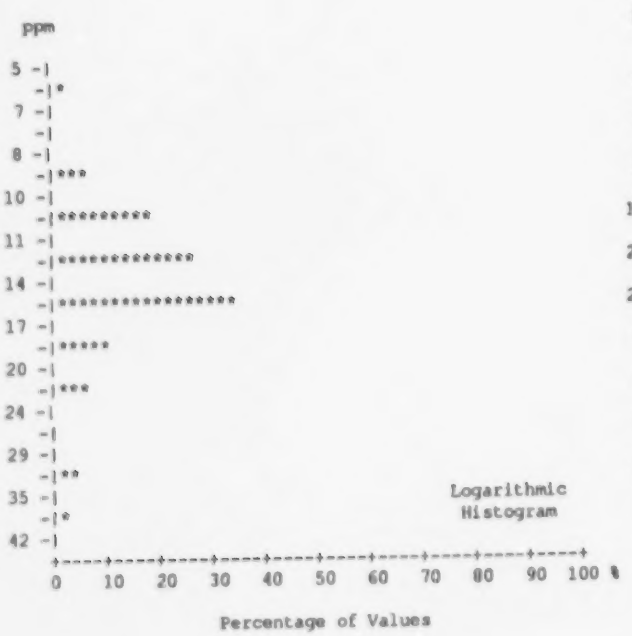
# Manganese (ppm)

| | All | uKK | 1J | 1K | muJA |
|---|---|---|---|---|---|
| N | 85 | 27 | 26 | 14 | 10 |
| N > DL | 12 | 3 | 5 | 1 | 2 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | 0.38 | 0.56 | 0.30 | 0.14 | 0.63 |
| Median | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Mode | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Range | 11.9 | 11.9 | 2.9 | 0.6 | 3.6 |
| St Dev | 1.39 | 2.29 | 0.61 | 0.16 | 1.19 |
| Coef Var | 3.604 | 4.090 | 2.023 | 1.122 | 1.887 |
| Log Mean | -0.839 | -0.883 | -0.797 | -0.940 | -0.690 |
| Geo Mean | 0.14 | 0.13 | 0.16 | 0.11 | 0.20 |
| Log StDv | 0.390 | 0.418 | 0.376 | 0.226 | 0.587 |
| Log CVar | -0.465 | -0.473 | -0.472 | -0.241 | -0.851 |
| Percntls | | | | | |
| Minimum | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 10th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 20th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 30th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 40th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 50th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 60th | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 70th | 0.1 | 0.1 | 0.2 | 0.1 | 0.1 |
| 80th | 0.2 | 0.1 | 0.2 | 0.1 | 0.2 |
| 85th | 0.2 | 0.1 | 0.3 | 0.1 | 1.7 |
| 90th | 0.3 | 0.1 | 0.3 | 0.1 | 1.7 |
| 95th | 1.5 | 0.4 | 1.5 | 0.1 | 3.7 |
| 98th | 3.0 | 0.4 | 1.5 | 0.7 | 3.7 |
| 99th | 3.7 | 12.0 | 3.0 | 0.7 | 3.7 |
| Maximum | 12.0 | 12.0 | 3.0 | 0.7 | 3.7 |

Histograms are not calculated for variables with fewer than 15 samples above the detection limit.

| Element Statistics |
|---|
| Variable - Silver [Ag] |
| Number of Values - 85 |
| Units - ppm |
| Detection Limit - 0.2 |
| Analytical Method - AAS |

# Silver (ppm)

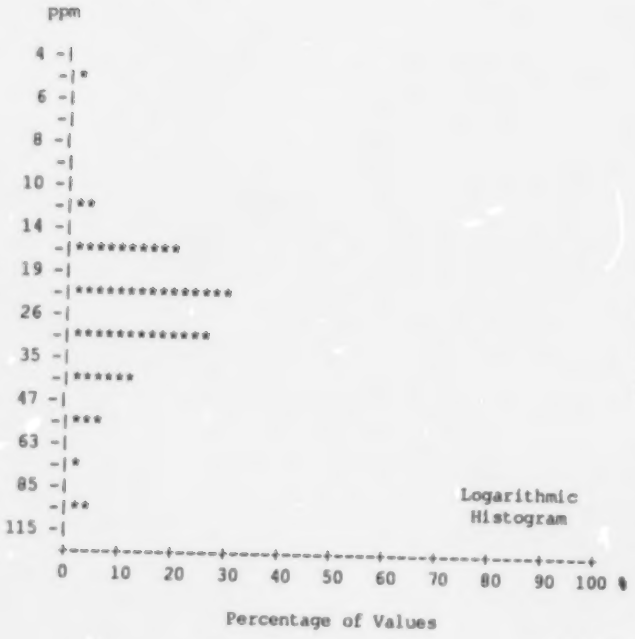



| ppm | N | % | Cum% |
|---|---|---|---|
| 5 | 1 | 1.2 | 1.2 |
| 7 | 0 | 0.0 | 1.2 |
| 8 | 5 | 5.9 | 7.1 |
| 10 | 15 | 17.6 | 24.7 |
| 11 | 21 | 24.7 | 49.4 |
| 14 | 28 | 32.9 | 82.4 |
| 17 | 7 | 8.2 | 90.6 |
| 20 | 4 | 4.7 | 95.3 |
| 24 | 0 | 0.0 | 95.3 |
| 29 | 3 | 3.5 | 98.8 |
| 35 | 1 | 1.2 | 100.0 |
| 42 | | | |

| Element Statistics | |
|---|---|
| Variable - Cobalt [Co] | |
| Number of Values - 85 | |
| Units - ppm | |
| Detection Limit - 2 | |
| Analytical Method - AAS | |

| | All | uKK | 1J | 1K | muJA |
|---|---|---|---|---|---|
| N | 85 | 27 | 26 | 14 | 10 |
| N > DL | 85 | 27 | 26 | 14 | 10 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | 14.4 | 14.6 | 13.0 | 16.1 | 17.2 |
| Median | 14.0 | 14.0 | 13.0 | 14.0 | 14.0 |
| Mode | 13.0 | 14.0 | 13.0 | 14.0 | 13.0 |
| Range | 29 | 12 | 23 | 22 | 22 |
| St Dev | 4.86 | 2.90 | 4.49 | 6.72 | 6.94 |
| Coef Var | 0.337 | 0.199 | 0.346 | 0.417 | 0.404 |
| Log Mean | 1.140 | 1.155 | 1.092 | 1.182 | 1.212 |
| Geo Mean | 13.8 | 14.3 | 12.3 | 15.2 | 16.3 |
| Log StDv | 0.124 | 0.084 | 0.134 | 0.145 | 0.139 |
| Log CVar | 0.109 | 0.073 | 0.123 | 0.123 | 0.114 |
| Percntls | | | | | |
| Minimum | 6 | 10 | 6 | 10 | 13 |
| 10th | 10 | 11 | 9 | 10 | 13 |
| 20th | 11 | 12 | 9 | 12 | 13 |
| 30th | 12 | 13 | 11 | 13 | 13 |
| 40th | 13 | 14 | 11 | 14 | 14 |
| 50th | 14 | 14 | 13 | 14 | 14 |
| 60th | 14 | 15 | 13 | 14 | 15 |
| 70th | 15 | 16 | 13 | 14 | 15 |
| 80th | 16 | 16 | 15 | 16 | 17 |
| 85th | 17 | 17 | 16 | 17 | 23 |
| 90th | 19 | 18 | 17 | 31 | 23 |
| 95th | 23 | 20 | 20 | 31 | 35 |
| 98th | 31 | 20 | 20 | 32 | 35 |
| 99th | 32 | 22 | 29 | 32 | 35 |
| Maximum | 35 | 22 | 29 | 32 | 35 |

# Cobalt (ppm)

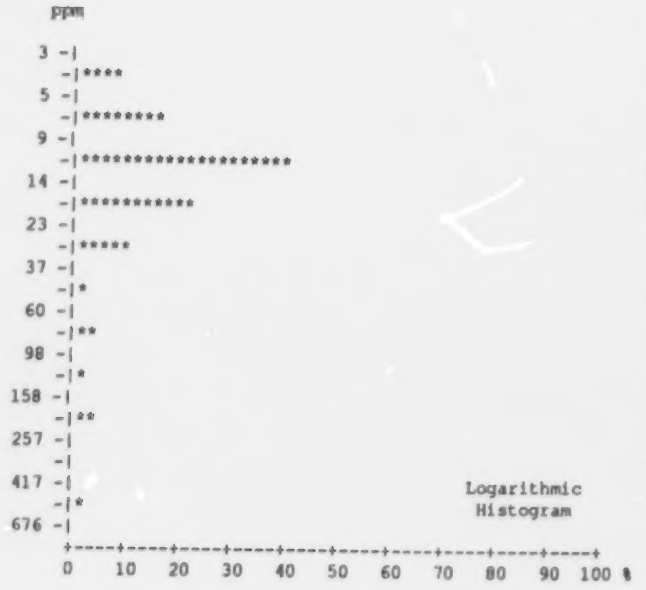



| | N | % | Cum% |
|---|---|---|---|
| | 1 | 1.2 | 1.2 |
| | 0 | 0.0 | 1.2 |
| | 0 | 0.0 | 1.2 |
| | 3 | 3.5 | 4.7 |
| | 17 | 20.0 | 24.7 |
| | 25 | 29.4 | 54.1 |
| | 21 | 24.7 | 78.8 |
| | 10 | 11.8 | 90.6 |
| | 5 | 5.9 | 96.5 |
| | 1 | 1.2 | 97.6 |
| | 2 | 2.4 | 100.0 |

| Element Statistics |
|---|
| Variable - Nickel [Ni] |
| Number of Values - 85 |
| Units - ppm |
| Detection Limit - 2 |
| Analytical Method - AAS |

| | All | uKK | 1J | 1K | muJA |
|---|---|---|---|---|---|
| N | 85 | 27 | 26 | 14 | 10 |
| N > DL | 85 | 27 | 26 | 14 | 10 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | 29.0 | 28.9 | 19.7 | 38.9 | 45.9 |
| Median | 24.0 | 27.0 | 19.0 | 37.0 | 40.0 |
| Mode | 22.0 | 22.0 | 16.0 | 19.0 | 23.0 |
| Range | 90 | 45 | 34 | 73 | 72 |
| St Dev | 15.76 | 9.97 | 6.19 | 18.59 | 24.92 |
| Coef Var | 0.544 | 0.345 | 0.314 | 0.478 | 0.543 |
| Log Mean | 1.414 | 1.439 | 1.272 | 1.550 | 1.612 |
| Geo Mean | 25.9 | 27.5 | 18.7 | 35.5 | 40.9 |
| Log StDv | 0.199 | 0.132 | 0.157 | 0.187 | 0.214 |
| Log CVar | 0.141 | 0.092 | 0.124 | 0.121 | 0.133 |
| Percntls | | | | | |
| Minimum | 5 | 15 | 5 | 19 | 23 |
| 10th | 16 | 19 | 13 | 19 | 23 |
| 20th | 19 | 22 | 16 | 22 | 23 |
| 30th | 21 | 23 | 16 | 25 | 26 |
| 40th | 22 | 25 | 17 | 32 | 34 |
| 50th | 24 | 27 | 19 | 37 | 40 |
| 60th | 26 | 28 | 21 | 41 | 42 |
| 70th | 32 | 32 | 21 | 42 | 43 |
| 80th | 37 | 33 | 22 | 43 | 48 |
| 85th | 41 | 34 | 25 | 48 | 85 |
| 90th | 43 | 34 | 26 | 52 | 85 |
| 95th | 55 | 55 | 28 | 52 | 95 |
| 98th | 85 | 55 | 28 | 92 | 95 |
| 99th | 92 | 60 | 39 | 92 | 95 |
| Maximum | 95 | 60 | 39 | 92 | 95 |

# Nickel (ppm)

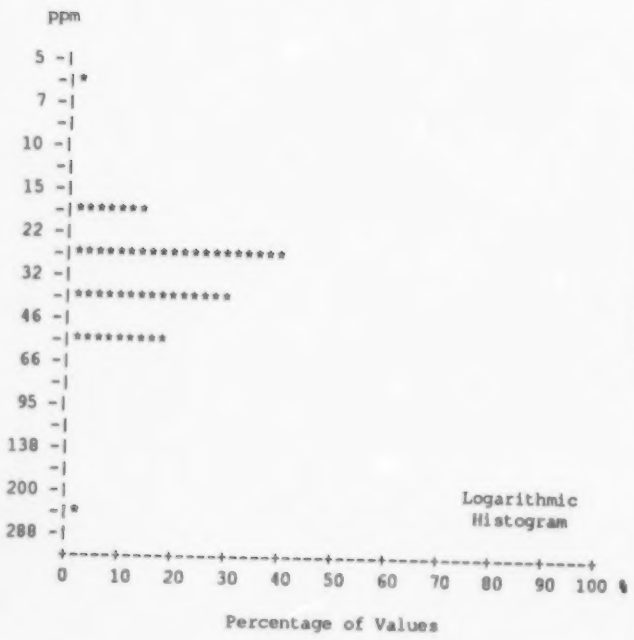



| | N | % | Cum% |
|---|---|---|---|
| | 6 | 7.1 | 7.1 |
| | 13 | 15.3 | 22.4 |
| | 34 | 40.0 | 62.4 |
| | 18 | 21.2 | 83.5 |
| | 7 | 8.2 | 91.8 |
| | 1 | 1.2 | 92.9 |
| | 2 | 2.4 | 95.3 |
| | 1 | 1.2 | 96.5 |
| | 2 | 2.4 | 98.8 |
| | 0 | 0.0 | 98.8 |
| | 1 | 1.2 | 100.0 |

| Element Statistics |
|---|
| Variable - Lead [Pb] |
| Number of Values - 85 |
| Units - ppm |
| Detection Limit - 2 |
| Analytical Method - AAS |

| | All | uKK | 1J | 1K | muJA |
|---|---|---|---|---|---|
| N | 85 | 27 | 26 | 14 | 10 |
| N > DL | 85 | 27 | 26 | 14 | 10 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | 26.4 | 20.9 | 36.0 | 16.8 | 40.3 |
| Median | 13.0 | 13.0 | 11.0 | 12.0 | 13.0 |
| Mode | 6.0 | 6.0 | 9.0 | 11.0 | 13.0 |
| Range | 528 | 185 | 527 | 58 | 207 |
| St Dev | 64.23 | 34.97 | 102.59 | 14.82 | 67.28 |
| Coef Var | 2.435 | 1.674 | 2.847 | 0.883 | 1.670 |
| Log Mean | 1.145 | 1.121 | 1.156 | 1.145 | 1.238 |
| Geo Mean | 14.0 | 13.2 | 14.3 | 14.0 | 17.3 |
| Log StDv | 0.367 | 0.352 | 0.424 | 0.233 | 0.521 |
| Log CVar | 0.320 | 0.314 | 0.366 | 0.203 | 0.421 |
| Percntls | | | | | |
| Minimum | 4 | 5 | 5 | 8 | 5 |
| 10th | 6 | 5 | 6 | 8 | 5 |
| 20th | 8 | 6 | 7 | 9 | 6 |
| 30th | 9 | 7 | 9 | 11 | 10 |
| 40th | 11 | 10 | 9 | 11 | 11 |
| 50th | 13 | 13 | 11 | 12 | 13 |
| 60th | 14 | 15 | 13 | 12 | 13 |
| 70th | 16 | 16 | 17 | 14 | 13 |
| 80th | 19 | 24 | 19 | 15 | 15 |
| 85th | 24 | 27 | 20 | 18 | 105 |
| 90th | 31 | 30 | 30 | 25 | 105 |
| 95th | 92 | 38 | 92 | 25 | 212 |
| 98th | 190 | 38 | 92 | 66 | 212 |
| 99th | 212 | 190 | 532 | 66 | 212 |
| Maximum | 532 | 190 | 532 | 66 | 212 |

# Lead (ppm)

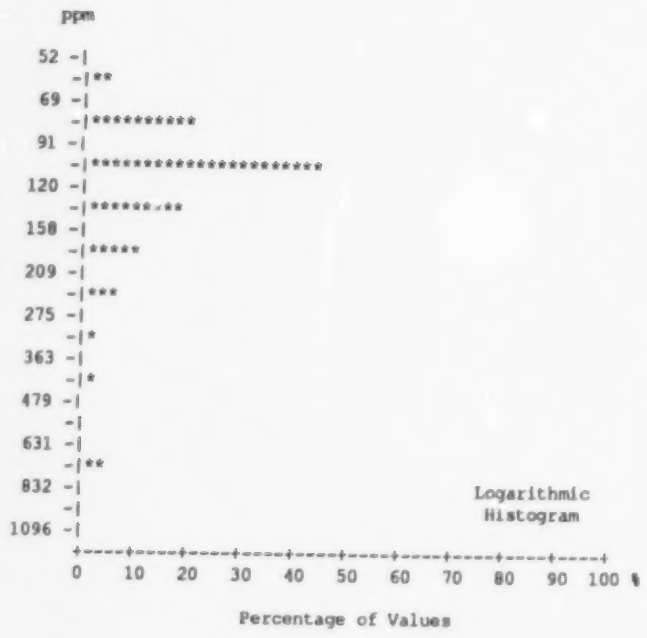



| | N | % | Cum% |
|---|---|---|---|
| | 1 | 1.2 | 1.2 |
| | 0 | 0.0 | 1.2 |
| | 0 | 0.0 | 1.2 |
| | 11 | 12.9 | 14.1 |
| | 33 | 38.8 | 52.9 |
| | 25 | 29.4 | 82.4 |
| | 14 | 16.5 | 98.8 |
| | 0 | 0.0 | 98.8 |
| | 0 | 0.0 | 98.8 |
| | 0 | 0.0 | 98.8 |
| | 1 | 1.2 | 100.0 |

| Element Statistics |
|---|
| Variable - Copper (Cu) |
| Number of Values - 85 |
| Units - ppm |
| Detection Limit - 2 |
| Analytical Method - AAS |

| | All | uKK | 1J | 1K | muJA |
|---|---|---|---|---|---|
| N | 85 | 27 | 26 | 14 | 10 |
| N > DL | 85 | 27 | 26 | 14 | 10 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | 35.4 | 30.5 | 37.4 | 35.4 | 39.0 |
| Median | 30.0 | 28.0 | 23.0 | 36.0 | 33.0 |
| Mode | 23.0 | 22.0 | 23.0 | 40.0 | 33.0 |
| Range | 263 | 38 | 263 | 32 | 33 |
| St Dev | 28.19 | 9.89 | 48.59 | 9.48 | 12.32 |
| Coef Var | 0.796 | 0.324 | 1.300 | 0.268 | 0.316 |
| Log Mean | 1.497 | 1.465 | 1.454 | 1.533 | 1.572 |
| Geo Mean | 31.4 | 29.1 | 28.4 | 34.1 | 37.3 |
| Log StDv | 0.192 | 0.132 | 0.268 | 0.130 | 0.134 |
| Log CVar | 0.128 | 0.090 | 0.184 | 0.085 | 0.085 |
| Percntls | | | | | |
| Minimum | 7 | 17 | 7 | 17 | 25 |
| 10th | 19 | 20 | 18 | 17 | 25 |
| 20th | 23 | 22 | 19 | 26 | 27 |
| 30th | 25 | 24 | 22 | 27 | 29 |
| 40th | 27 | 27 | 23 | 34 | 33 |
| 50th | 30 | 28 | 23 | 36 | 33 |
| 60th | 34 | 29 | 28 | 40 | 34 |
| 70th | 40 | 33 | 34 | 40 | 43 |
| 80th | 43 | 37 | 40 | 42 | 53 |
| 85th | 48 | 40 | 43 | 42 | 55 |
| 90th | 50 | 43 | 44 | 49 | 55 |
| 95th | 55 | 50 | 49 | 49 | 58 |
| 98th | 58 | 50 | 49 | 49 | 58 |
| 99th | 60 | 55 | 270 | 49 | 58 |
| Maximum | 270 | 55 | 270 | 49 | 58 |

# Copper (ppm)




| | N | % | Cum% |
|---|---|---|---|
| | 3 | 3.5 | 3.5 |
| | 17 | 20.0 | 23.5 |
| | 36 | 42.4 | 65.9 |
| | 14 | 16.5 | 82.4 |
| | 7 | 8.2 | 90.6 |
| | 4 | 4.7 | 95.3 |
| | 1 | 1.2 | 96.5 |
| | 1 | 1.2 | 97.6 |
| | 0 | 0.0 | 97.6 |
| | 2 | 2.4 | 100.0 |

| Element Statistics |
|---|
| Variable - Zinc (Zn) |
| Number of Values - 85 |
| Units - ppm |
| Detection Limit - 2 |
| Analytical Method - AAS |

| | All | uKK | 1J | 1K | muJA |
|---|---|---|---|---|---|
| N | 85 | 27 | 26 | 14 | 10 |
| N > DL | 85 | 27 | 26 | 14 | 10 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | 139.2 | 111.5 | 148.5 | 162.3 | 163.4 |
| Median | 110.0 | 94.0 | 108.0 | 104.0 | 117.0 |
| Mode | 95.0 | 80.0 | 140.0 | 94.0 | 110.0 |
| Range | 769 | 234 | 731 | 732 | 280 |
| St Dev | 117.73 | 54.49 | 140.34 | 193.14 | 87.61 |
| Coef Var | 0.846 | 0.489 | 0.945 | 1.190 | 0.536 |
| Log Mean | 2.081 | 2.013 | 2.098 | 2.098 | 2.169 |
| Geo Mean | 120.4 | 102.9 | 125.5 | 125.3 | 147.4 |
| Log StDv | 0.196 | 0.164 | 0.210 | 0.253 | 0.197 |
| Log CVar | 0.094 | 0.082 | 0.100 | 0.120 | 0.091 |
| Percntls | | | | | |
| Minimum | 56 | 56 | 75 | 93 | 92 |
| 10th | 82 | 68 | 84 | 93 | 92 |
| 20th | 88 | 80 | 88 | 94 | 97 |
| 30th | 95 | 83 | 95 | 95 | 110 |
| 40th | 100 | 87 | 100 | 98 | 110 |
| 50th | 110 | 94 | 108 | 104 | 117 |
| 60th | 116 | 100 | 128 | 105 | 125 |
| 70th | 125 | 112 | 140 | 113 | 174 |
| 80th | 144 | 120 | 144 | 115 | 202 |
| 85th | 165 | 138 | 160 | 119 | 235 |
| 90th | 204 | 145 | 165 | 212 | 235 |
| 95th | 266 | 266 | 257 | 212 | 372 |
| 98th | 372 | 266 | 257 | 825 | 372 |
| 99th | 806 | 290 | 806 | 825 | 372 |
| Maximum | 825 | 290 | 806 | 825 | 372 |

# Zinc (ppm)

MAPS
NOT
FILMED

CARTES
OMISES